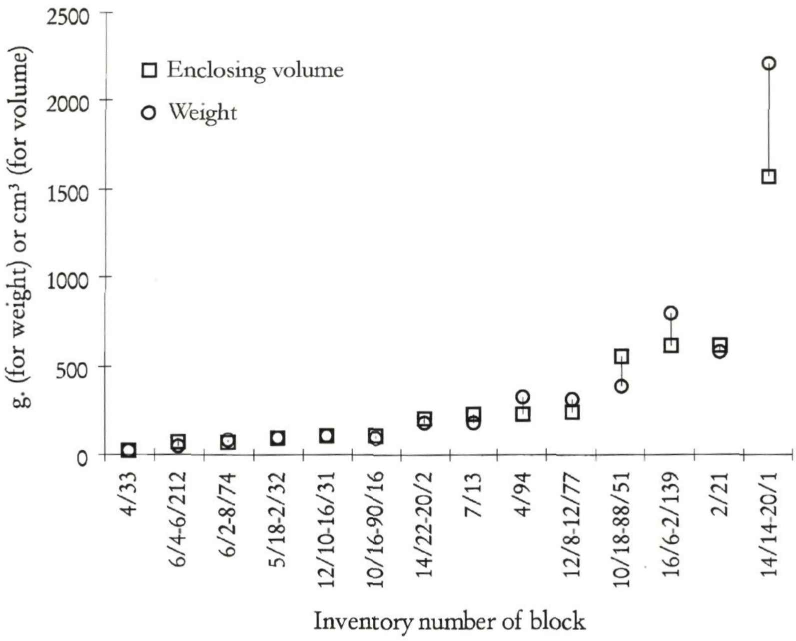
4.5.1.2 *Size*

As discussed in section 4.3.3, weight values of the 14 'tested blocks' found at the site, indicate that sizes of the selected cobbles were equally extremely variable, ranging from 21 g to 2206 g, with a mean value of 388 ± 547 g. Enclosing volumes of the same items range from 22cm≈ to 1573cm≈. The 'enclosing volume' of a flint block is here simply expressed as a multiplication of length x width x thickness, or in other words as the volume of a right-angled hexahedron that precisely encompasses the flint block. Because of the irregular shape of any flint cobble, this provides only a general estimation of its actual size. However, as shown by fig. 29, the values of weight and enclosing volume show a remarkable correlation, in the sense that on average 1cm≈ of the enclosing volume tends to correspond more or less to 1g of the flint cobble weight. The advantage of the former measure is that it allows us to estimate the size of the blocks of which the perimeter has been more or less reconstructed, but of which interior parts are missing. Weight alone, therefore, would not provide an accurate measurement in these cases.

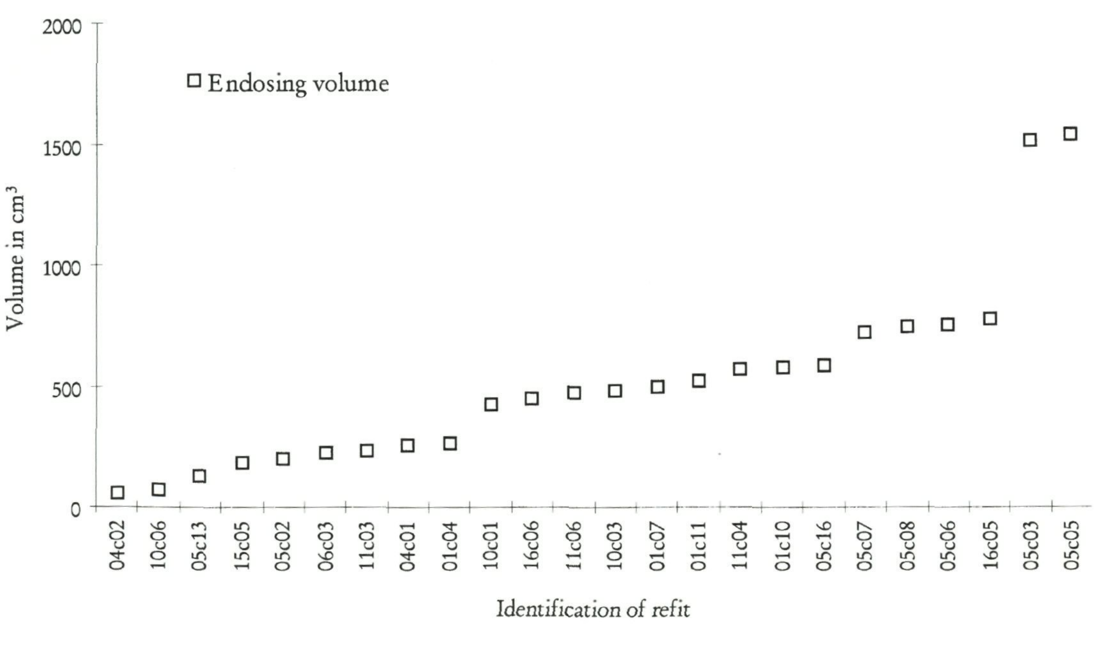
In all, 25 co-sets could be refitted to a degree that permitted a good estimation of the dimensions of the initial nodules (see section 4.4.2 and corresponding plates). Their enclosing volumes range from 59cm≈ to 1534cm≈, with one outlier of 5363cm≈. The latter – co-set 16c01 – is in fact a very unusual case at Rekem (for several reasons; see its description in section 4.4.2.11), and is therefore not considered here. The enclosing volume of the other co-sets is graphically presented on fig. 30. Comparison of these results with those of the 'tested blocks' (fig. 29), reveals that the latter are generally somewhat smaller (which possibly explains the rejection from the debitage of some of the tiniest elements).

The mean enclosing volume of the 24 refitted co-sets is 509 ± 373cm≈. Fig. 30 shows that a series of blocks approximate to this volume measure, which more or less corresponds with the size of the fist of a human adult. In terms of weight, their average may have approached 0.5 kg, indeed exceeding the average weight of the tested blocks. However, as is shown by the large standard deviation, and the other

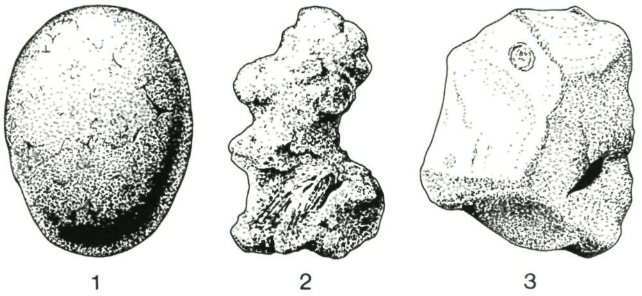
29 *Rekem 1984-86. Enclosing volume and weight of tested blocks.*



30 *Rekem 1984-86. Enclosing volume of (almost) completely reconstructed blocks.*



31 *Highly schematized classification of shapes of original blocks exploited at Rekem.*



pieces plotted on fig. 30, the sizes of the cobbles that were selected for knapping purposes, are still notably varied.

Again, it may be concluded that, although some preference may have existed for fist-size nodules, in terms of size, flint procurement selection mechanisms were not adopted very strictly.

4.5.1.3 Morphology

As could be conjectured, a similar conclusion must be drawn with regard to the variability of the flint cobble shapes. There were apparently no specific morphological preferences. In highly simplified terms, three general types may be distinguished (fig. 31):

1. Spherical, sub-cylindrical or egg-shaped nodules, often with a smooth cortex, though other aspects also occur (*e.g.* 04c01, 04c02, 05c02, 05c13, 12c04)
2. 'Knobbed forms', *i.e.* irregularly shaped nodules covered with salient protuberances (*e.g.* 05c05, 05c06, 10c03, 15c01, 15c02, 16c05), deep cavities (*e.g.* 01c10, 05c21, 06c01, 10c01), or combinations of the two; normally coated with a chalk cortex, but other aspects occur.
3. Real polyhedrons (angular blocks), with numerous flat surfaces meeting at acute edges (ridges); nothing but an extremely worn cortex covered these nodules (*e.g.* 01c07, 05c03, 05c16, 10c02, 16c02).

These forms, while very diverse, do certainly not account for the whole variability. Some blocks combined several features of the descriptions above, but other types, such as flat slabs (*e.g.* 01c04, 10c06, 12c03, 15c03), or very peculiar forms (*e.g.* the completely hollow stone of 05c04), were equally collected. As stated earlier, several reductions also exploited fragments of broken blocks. In conclusion, the flint knappers at Rekem exploited a wide range of stones. We will in the following paragraphs argue that, whatever the initial form, the knappers always tried to take advantage of its appearance, in a most profitable way.

4.5.2 Shaping out and maintenance of the core

It is generally acknowledged that several technical procedures are advantageous when a piece of flint is to be prepared for proper (laminar) debitage: roughing out and cortex removal (to delimit the number of irregular and cortical blanks during the '*plein débitage*'), cresting (to create a ridge that can guide the opening removal of the laminar reduction sequence), and platform preparation (to provide a surface for striking). We will shortly examine how these processes were adopted by the *Federmesser* knappers.

4.5.2.1 Cortex removal and roughing out

At Rekem, we could not allocate reduction episodes on the refitted co-sets which would strictly have served to decorticate the flint cobbles. The few examples where a sub-sequence mainly consisted of cortex removal (*e.g.* 05c15, 05c19), are in fact too limited reconstructions for an appropriate evaluation of their exact technical significance. On most of the more substantially refitted co-sets, removal of the cortex appeared not to have been a purpose in itself. Generally, it concurred with the implementation of other functions, such as the installation of a striking platform or the immediate initiation of the proper (laminar) reduction.

The latter case is often observed on the polyhedral blocks of type 3: while one of the natural planes served as a striking platform, a perpendicular acute edge was exploited to guide the first blank, immediately launching the primary laminar series which accordingly yielded cortical blades (*e.g.* 05c03, 05c08). Similarly, although the first reduction stage on the 'knobbed' nodules of type 2 might be assessed as an intentional decortication process, it is not the removal of the cortex as such that seems to have inspired the knapper. Probably, rather the eye-catching shapes of the knobs – which coincidentally were mostly cortical – were targeted (cf. 05c21, 10c03). Removing these must have been quite simple, and it often ventilated an appropriate surface which could be employed as a striking platform to immediately launch the first laminar series (*e.g.* 05c05, 05c06). Finally, the regular egg-shaped nodules (type 1) were also not substantially decorticated : after removal of one of the narrow extremities, the laminar reduction was immediately initiated along the most narrowly curved side of the nodule, again yielding cortical blades during the primary series (*e.g.* 05c02, 05c10).

It may therefore be concluded that, whereas the initial blanks of any reduction sequence are obviously cortical, at Rekem, a decortication sub-sequence with the merest intention to 'shell' or to 'peel' the flint nodule could not be diagnosed. In fact, because of the limited efforts generally invested in the shaping out of the cores, even 'pseudo-decortication' was limited. In addition to the cortex, a range of (other) irregularities often subsisted on the blocks. They were

– or were not – sporadically removed in the course of the further reduction process.

The only occasion where the presence of cortex may have been 'problematic' was when it occurred as a thick chalk layer on the striking platform. This was clearly observed on co-set 10c01, where a platform with thick chalk cortex (A) was systematically prepared (facetting), whereas the opposite platform (B), devoid of chalk cortex, was exploited without any adjustment.

4.5.2.2 Cresting

Whereas the flintknappers at Rekem were certainly aware of cresting as an advantageous technical means, obviously, they did not apply this procedure in any systematic way. In the above paragraphs we already drew attention to the recurrent use of natural edges as initial guiding ridges. Although it cannot be asserted that nodules were selected specifically for these characteristics, clearly, blocks with internal flaws, always potentially providing such sharp ridges, were not at all rejected. When no such ridges were available, a narrowly curved side was often directly exploited to guide the first laminar blank. In the subsequent reduction, the intersection of the core table with the flank then functioned as a guiding ridge, without any intervention of cresting (*e.g.* 05c10, 05c02, 05c20).

The active application of a crest was observed in a few circumstances, though:

1. When a natural ridge was present, this at times was still modified into a crest, mostly only slightly affecting the shape of this ridge (*e.g.* 01c07, 05c16), but on occasion skilfully created (*e.g.* 05c01, 05c07A). In the latter case, unifacial cresting seemingly served to partially displace the natural ridge more centrally on the dorsal face of the future blank (*e.g.* 01c06, 10c06).
2. When two tangential large negatives had been obtained after the 'pseudo-decortication' of type 2 nodules (see above), the edge of one of these, meeting the remaining cortex, was sometimes slightly crested, perpendicular to an other negative which would subsequently serve as a striking platform (*e.g.* 05c05).
3. Halfway through a reduction sequence, cresting occasionally served to correct flaking accidents, or to remove the subsisting irregularities of the initial volume (*i.e.* '*néo-crêtes*'; *e.g.* 05c03, 05c08).
4. Cresting as an aid to maintain the shape of the core, and especially, to convert a flat core table into a more curving surface, has been hardly observed (perhaps on co-set 10c01, but production ended there after removal of the crest).

On almost every occasion, cresting involved the preparation of one versant only (unifacial crests). Generally, the number of transversal negatives left on the crest by the preparatory flakes, is also very limited. The angle of the crest ('*cintre*') tends to be rather wide.

Crests usually did not function as a central ridge on the core table, but were regularly situated near the edge of the flaking faces, where the preparation equally accommodated the lateral flank(s) (*e.g.* 01c05, 01c06). This accommodation was sometimes executed with a single lateral removal (01c06). Cresting of the back of the core is rare.

When two crests appeared within a single sequence, they were generally situated on the same location of the core (*e.g.* 01c04, 07c08). Sometimes, the second crest merely replaced the initial one, the removal of which had (partly) failed (05c07). In all, some 45 crest preparations have been observed within the 86 reconstructed co-sets.

Finally, it should be noted that, although the primary function of the crests (and of the ridges) was clearly to guide the opening blank of a (laminar) generation, not all crest removals are indeed followed by such a blade reduction sub-sequence. Sometimes the sequence terminated with the detachment of the crested blade (*e.g.* 05c07A, 10c01), while occasionally a prepared crest was not even extracted (*e.g.* 05c07B).

4.5.2.3 Platform preparation and renewal

Platform preparation and renewal at Rekem generally affected only a part of the striking platform, and rarely produced real core tablets (see section 4.3.2.2.). The orientation of the tabular flakes on the striking platform is very variable. Rejuvenation flakes could be struck from the core table, but also from the flanks. Real centripetal preparation also occurred, though this was rare (*e.g.* on co-set 04c02). A platform rejuvenation phase was generally followed by a series of several removals along the core table. More rapid platform renewal (facetting of isolated blades) has only been observed in a few instances (*e.g.* on co-set 07c06).

In the (rare) event that both a crest and a platform were prepared, the former was generally installed before the latter (*e.g.* 01c12, 07c06, 10c02), but the opposite order also occurred (*e.g.* 07c03). More often than not, however, at least one of these preparatory phases was lacking in the reductions at Rekem. As stated earlier, the polyhedral blocks of type 3, as well as flawed nodules (chunks), could immediately be reduced in an unprepared state, using a 'natural' plane as the striking platform. The removal of a large knob from the type 2 nodules also frequently installed a convenient platform. Only the detachment of one of the extremities of the type 1 nodules may be considered as a straightforward platform installation.

Rejuvenation of the platforms in the course of the reduction sequence was a more common practice. It was often applied in order to readjust the flaking angle, when removals along the core table started hinging (*e.g.* 01c01, 01c04, 11c04).

Occasionally, a single platform served throughout the entire (unidirectional) reduction sequence (*e.g.* 01c01C, 01c04, 01c08, 05c05, 05c10, 06c02, 06c03, 15c05). In most instances, however, two opposed striking platforms were used. Although the second platform was sometimes installed to correct flaking accidents on the core table, it could quickly take over the role of primary striking surface. It has been noted that some platforms were frequently rejuvenated when the orientation of the reduction shifted, probably to adjust the platform angle to the new situation of the reduction face. Former core tables could in a later stage also be utilised as a striking platform, thus employing the re-orientation of the flaking direction as a rejuvenation technique (in these cases, more than two striking platforms were used). Sometimes, a flank of the core then served as a new reduction surface (*e.g.* 05c03, 16c03), but instances of the former striking platform being reconverted into a core table are also encountered (*e.g.* 07c03). The frequent alternation of this procedure implies that a distinction between striking surface and reduction surface is sometimes hard to make (*e.g.* 15c03). Yet another variant is observed on co-set 10c06, where there is a peculiar interchangeable use of striking platforms and core tables on a core with a triangular shape.

In the cases where a core could be conjoined within a reconstruction, the core often appeared to have lost some of the platforms which had been actually used during the reduction sequence (*e.g.* 07c07). This implies that the number of striking platforms counted on the cores (section 4.3.3) only provides a minimal estimate.

Within the more complete refits, three striking platforms were rejuvenated up to six times (05c03). Four rejuvenation episodes on a single platform appeared to be exceptional (01c01), but three renovations were repeatedly observed (*e.g.* platform (B) of 05c03, platform (B) of 05c08, platform (A) of 05c14, and on the single platforms of 05c05, 05c10, and 06c02). Altogether, about 90 platform preparations (both installations and rejuvenations) have been counted on some 50 platforms on 30 co-sets with a sufficient degree of refitting to estimate the number of platform renovations. On the whole, this is a rather low number. One could argue that the knappers probably tried to minimise the reduction of the core table length, in order to preserve a workable volume. On the other hand, it appears that in the case of hard-hammer percussion, the exterior platform angle ('*angle de chasse*') may be rather obtuse, and the platforms therefore did not require intense renewal[23]. In fact, the more the platform angle approaches 90 degrees, the longer the flakes[24].

Although the primary function of a platform rejuvenation was to supply a subsequent generation with optimum knapping conditions (as was the function of the crests), not all of the platform reductions headed such a series. Cores were sometimes abandoned immediately after this 'preparation' (*e.g.* 05c17, 07c05).

In conclusion, the initial shaping and maintenance of the cores at Rekem was a very versatile process, largely guided by the shape of the original nodule or the changing state of the core, and essentially focusing on an immediate production of a consumable (laminar) output. If ever the nodule presented a ready-to-exploit volume, it was indeed readily exploited. In such cases, no preparation preceded the laminar reduction sequence. On some occasions, however, a special effort seems to have been made in the application of elaborate preparations. In these particular cases, most of the blades, which must have been produced, could not be refitted. While this does not in itself prove that they are completely absent, it is nevertheless tempting to infer that these specimens were taken off-site.

4.5.3 Laminar production

4.5.3.1 Method

As shown by the analysis of the cores (section 4.3.3) and by the choices of the blank types selected for tooling (section 4.5.5, and chapter 5), the flintworking at Rekem principally targeted a laminar production (blade(let)s or laminar flakes). This seems to contradict the apparent lack of pre-planned organisation during the initial shaping of the cores, since the blades in a narrow sense (L>=2W, parallel edges and parallel ribs) are such a strictly defined artefact-type that the reduction strategy normally comprises elaborate preparatory stages.

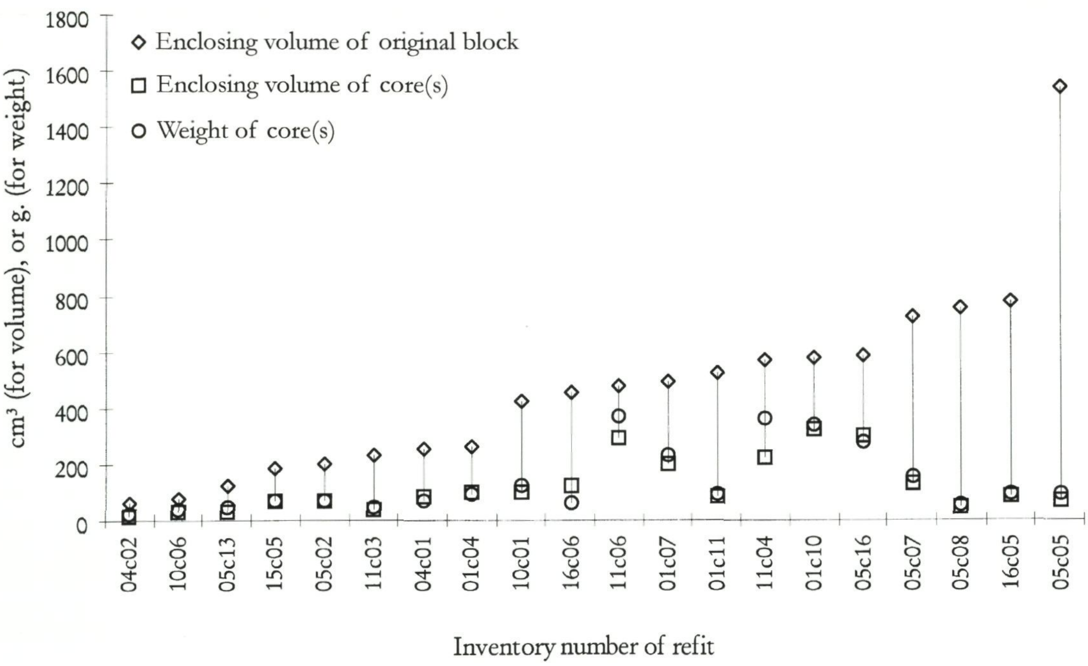
As a consequence of the opportunistic exploitation of the raw material, the initial laminar products at Rekem were generally large and thick elements, often with a triangular cross-section, and with thick, unprepared butts. They principally served to 'open' the reduction face (*e.g.* 05c03, 06c02, and many others). Once the exploitation of a core table was initiated along a ridge (or crest), the reduction was directed semi-peripherally away from that starting point (05c01, 10c01, 10c02).

A laminar generation generally consisted of only a few removals. After the detachment of the opening blade, the following specimens were inclined to become gradually shorter (well-illustrated, *e.g.* on 10c06, and on 07c07, where length of the blades decreased from 8 to 4.5cm). On the other hand, the size of the successive products generally fluctuated considerably varying from large thick flakes, to narrow, thin removals, partly induced by a significant variation of the hammer position on the striking surface. However, the elongated flakes and blades generally travelled between half and the totality of the core table length, mostly exploiting about 2/3 of it.

Another major reason for the rapid ending of the laminar generations, was the quick appearance of hinging accidents, partly as a result of the overall rectilinear profile of the core tables. Platform renewal was one way to deal with these knapping accidents. Another, and more common way to eliminate those hinges, was to start the exploitation from the opposite end of the core (*e.g.* 01c06, 05c17, 11c04, 16c02).

The rhythm of the change of knapping direction is highly variable, and was certainly not directed by the knapping accidents alone. From a morphological point of view, the most regular blades were, in fact, produced with a rapidly successive extraction along a single core table from two opposed, rarely

23 Valentin 1995, 512.
24 Whittaker 1994, 91.



32 *Rekem 1984-86. Comparison between enclosing volumes of (almost) completely reconstructed blocks on the one hand, and of abandoned cores on the other hand.*

rejuvenated, striking platforms (*e.g.* 05c09). As shown by the refits, this method could yield up to at least seven laminar series. As far as we know, and although it occurs rarely at Rekem, such rhythm has never been reported on sites like Meer II or Pincevent[25], nor has it been reported in any *Federmesser* assemblage of the Paris Basin[26]. In view of the absence of preparatory elements and of the core in this refit, a non-local production (import of blades), might be envisaged. Other co-sets, however, even if less conspicuous, do confirm the application of a rapidly inverting reduction direction yielding comparable high-quality blades. For example, 05c17, which is equally lacking in preparatory stages, but which integrates a core and 05c20, where, besides the core, a few platform rejuvenations could be refitted, though in this case, the best blades seem to be absent. Finally, repeated platform alternation has been observed within various sequences which did not necessarily produce 'good quality' blades (*e.g.* 04c02, 07c06). Alternatively, it was also noted that it was not the platforms but rather the opposed core tables, which were exploited in a strictly successive way (*e.g.* 05c04).

As a consequence of the gradually decreasing dimensions of the core, the terminal stages of the sequences often produced small blades and bladelets. On several occasions, this had to be interpreted from the negatives left upon the refitted cores (05c08, 05c20), as rather few bladelets could actually be refitted. No special core treatment seems to have accompanied this bladelet production. Occasionally, bladelets were also produced sporadically (by chance?) during the earlier stages of the reduction sequences. Whether cores were also intentionally selected for bladelet production, as seems to be the case for some co-sets (04c02, 10c06), remains enigmatic. For the moment, we fail to grasp the ultimate goal of these sequences. In fact, the only tools initially thought to be made from bladelets, *i.e.* slender lateral modified laminar pieces, after refitting, actually appeared to have been manufactured on small blades (section 4.5.5 and chapter 5).

Whereas many flakes were evidently refitted within the various sub-sequences of the co-sets, some reconstructions also point at a serial production of flakes (*e.g.* 05c15, 05c19, 06c06, 11c01, 11c02). These flake series were simply obtained by reducing the nodule unsystematically from different directions. However, it remains difficult to establish whether this was indeed an intended production, or merely the work of less skilled knappers. On yet other occasions, the limited refitting results of the co-sets may possibly hide their actual technical function (*e.g.* 13c01, 13c02).

In conclusion, the majority of the reconstructed sequences at Rekem reveal a strategy that can be described as a 'simplified laminar reduction method' ('*débitage laminaire simplifié*'[27]). The shape and volume of the original nodules (not only '*allongé et assez plat*' like at Meer II, but of different morphologies, cf. supra), was in these sequences opportunistically exploited to directly launch laminar series. Knapping then continued to procede in a very flexible manner, resulting in an output of unstandardised products.

4.5.3.2 *Productivity*

Apart from the fluctuating character of the flint knapping production in qualitative terms, the sequences also generated an extremely inconstant output in quantitative terms. This is well illustrated on fig. 32 which compares the volume of the original blocks with the size of the abandoned cores for well-reconstructed refits[28] where both those measure-

25 Cahen *et al.* 1980, 216.
26 Valentin 1995, 540.
27 Cf. Cahen 1978, 63-64.
28 In case more than one core occurred in a refitted co-set, the volumes of the various cores were added up (*i.e.* at 01c04, 05c07, 10c06, 11c04, and 11c06).

ments could be taken. Altogether 20 of the almost completely refitted co-sets including their core(s) could be used in this exercise.

Fig. 32 clearly reveals a lack of correlation between the sizes of the original volumes and those of the ultimate cores. When expressed as a ratio, the reduction indexes[29] range from less than 2 (for 11c06, 01c10, and 05c16), to more than 15 (for 05c08 and 05c05). In other words, some cores were abandoned before half of the original volume had been consumed, while other knapping sequences managed to transform more than 90% of the raw material into flakes and blades. On average, the nodules were reduced to about one fifth of their initial volume (*i.e.* a reduction index of 5.2, but, as expected, with an extremely large standard deviation of ± 4.9!). In all, this result does not differ too much from the overall reduction index of 4.2, calculated by dividing the total weight of the flint material at habitation zone 1 (74.2 kg) by the total weight of the cores (17.8 kg; see also section 4.5.4).

The extreme variation in terms of volume-reduction between the different co-sets, evidently implies that the number of artefacts by reduction sequence was also highly variable. Good estimations are here much more difficult to make. Still, we believe that a yield of 100 artefacts (chips excluded) per reduction sequence was certainly about the maximum produced at Rekem[30]. Our best refitted co-sets (*e.g.* 01c01, 05c03, 05c05) may have approximated this amount. On the other hand, some sequences produced only a few removals (01c10, 05c16, 15c01). In all, an average production of some 50 artefacts per sequence seems to be an accurate assessment. This is in more or less accord with the data from the general inventory (Table 13): about 200 cores seem to have yielded some 10000 artefacts (excluding the chips). In very general terms, this implies that at Rekem, the number of 'imported' artefacts is more or less equivalent to the number of 'exported' items. However, as emphasised above, this is a highly variable aspect, with significant inter-locus variability (see also section 4.6.3).

Obviously, another measure to estimate the productivity of the reduction sequences is by counting the desired (end)products. Assuming that the knappers aimed at making blades, the productivity ranged from zero (many reduction sequences failed to produce any blade!), to a production of some two dozen laminar elements on the most productive co-sets (*e.g.* 01c01, 01c05, 05c08, 05c20). However, as shown in section 4.5.5, regular blades were certainly not the only blanks selected for tooling. On the whole, any index claiming to represent a truly accurate assessment of the productivity of the flintknappers at Rekem, should be pondered with some caution.

4.5.4 Core discard

In an economy focusing on blank production cores, by nature, are debitage waste products[31]. They are normally discarded when further exploitation is for some reason no longer possible or opportune. In our attempt to identify the reasons for the discard of individual cores, we took into consideration the observation that the mastery of laminar debitage depends on the control of the distal ends. These must not be hinged[32] or else the debitage will quickly grind to a halt[33]. We also considered the facts that internal flaws or irregularities in the flint material can impede further reduction, that knapping can provoke uncontrolled breakage of the volume, and finally, of course, that the core being reduced at a certain stage arrives at a size that can hardly be further exploited with hand-held percussion flaking.

When applied to the total core assemblage, the highest score of the possible causes of rejection was marked by the occurrence of scars of hinging removals. In fact, not less than 44% of the reduction faces carried at least one indication of hinging (Table 28). Hinging of flakes was also repeatedly identified as a cause of discard in the analysis of the refitted co-sets (*e.g.* 01c04, 01c08, 05c13, 05c17, 05c21, 07c07, 11c03, 11c06, 15c03).

Other possible reasons for discard have been far less frequently observed: 11% of the cores suffered from uncontrolled and fatal breakage, 4% contained internal flaws or irregularities in the body of flint, and 3% were abandoned after the plunging of a final removal. However the refitting evidence showed that the plunging of flakes did not automatically lead to the fatal rejection of a core. In fact knappers occasionally took advantage of the additional convexity created by such heavy overpassing (*e.g.* co-set 10c02), or started to exploit the opposite side of the core (*e.g.* set 06s11). Finally, we estimate that another 11% of the cores were completely exhausted in terms of size (although this is a particularly subjective topic of evaluation).

In all, this means that for almost 30% of the cores, it was unclear to us why knapping had stopped at that specific point. Some cores were for instance conveniently prepared, both on top and laterally, but then hardly exploited (*e.g.* Pl. 14). This group also includes nearly all of the tested blocks, as well as a majority of the globular-shaped cores. On the latter, a lack of suitably sharp ridges may possibly have hampered further reduction, a remark also forwarded for some

29 *i.e.* the enclosing volume of block divided by the enclosing volume of core(s).

30 To our knowledge, *'Federmesser'* refits containing more than 100 artefacts have not been reconstructed so far. Such reconstructions were indeed possible elsewhere, for instance in some Magdalenian sites; *e.g.* more then 300 artefacts per co-set in Etioles (Pigeot 1987, 13). Yet, this high number is not common on all Magdalenian sites. In Marsangy, for instance, refits rarely include more than 40 specimens, even when they are almost 'complete' (Schmider n.d., 99).

31 In case this statement requires confirmation: of 14 (refitted) cores subjected to microwear analysis, not a single specimen presented microscopic traces of use. Exceptionally, isolated impact marks of percussion could be observed on the reduction face of some cores, but it is often unclear whether they were induced by failed attempts of core trimming or really result from the use of the core as hammer stone.

32 Hinging of flakes is especially inopportune when it occurs close to the striking platform. Repair of the core table from an opposite platform (if present) is in such cases very difficult.

33 Inizan, Roche & Tixier 1992, 61.

Table 28
Rekem 1984-86. Cores: possible reasons for discard of various core types.

Possible reason for discard	Morphology (shape) of core: Prismatic	Pyramidal	Globular	Flat	Irregular	Broken	Tested block	Total	%
No obvious reason	19	6	11	8	5	4	10	63	29%
Final removal(s) hinged	49	19	5	2	10	1	-	86	40%
Final removal(s) plunged	1	4	-	-	-	1	-	6	3%
Flaws or irregularities in flint	2	-	-	2	1	-	2	7	3%
Broken	2	-	-	-	-	20	1	23	11%
Size (exhausted)	9	6	1	3	2	-	1	22	10%
Hinging + irregularities in flint	-	-	-	-	2	-	-	2	1%
Hinging + size	3	3	-	-	-	-	-	6	3%
Total	85	38	17	15	20	26	14	215	100%

of the refitted co-sets (*e.g.* 05c16). Insufficient transversal convexity (perpendicular to the ridges), occasionally due to the (accidental) knapping of very wide flakes (core flanks) which removed all the suitable ribs from the reduction face (*e.g.* in co-set 05c20), might also be a cause of the rejection of some other cores. Still, it seems that the cores at Rekem were often not exploited to the maximum. In fact, many of the specimens with hinging removals probably could also have been successfully repaired (using the opposed platform), if necessary. Whether or not this 'spoliation' of cores may be related to a sufficient and easy to reach provision of flint, will be further discussed below (section 4.6.1). In all, the discard of cores at Rekem was apparently not directed by rigorous criteria, but was rather a remarkably variable event.

This variability is also reflected in the size of the cores, as is shown on the length-width scatter diagram (fig. 28). Even when tested blocks and core fragments are excluded from the sample, the length, width, and thickness of the cores still range respectively from 25mm to 115mm, from 15mm to 90mm, and from 13mm to 78mm. Averages of length, width, and thickness are 54 ± 15mm, 40 ± 14mm, and 34 ± 14mm. As a consequence, the weight of the cores varies extremely, ranging from hardly 9g for tiny specimens (Pl. 12: 3) to about 500g for the most heavy examples (Pl. 13 & Pl. 60), and with an average of 95 ± 86 g. It may be interesting to note, however, that the sizes of the original cobbles were apparently even more variable: the weight of the 14 'tested blocks' ranges from 21g to 2206g. The mean weight of these specimen is 388 ± 547 g.

Despite the extremely large standard deviation of the latter measurement, it might still provide a good overall indication of the average magnitude of the original blocks which had been transported to the site for reduction: a rough calculation suggests that with a total inventory of about 80kg of flint recorded at Rekem, and with some 200 cores, the mean weight of the original blocks must have fluctuated around 400g. As noted earlier (section 4.5.3.2), in terms of weight, the cores at Rekem on average thus kept about a quarter of their original volume (general reduction index = 4.2).

Altogether, more than half of the cores (107 of 191, or 56%) could be assembled in debitage refits within habitation zone 1 (Table 29)[34]. This amounts to about 60% if tested blocks are excluded. In fact, the primary flakes, which had been detached from the latter, were never found on the site (Table 30). It seems therefore that the blocks collected during the procurement of raw material were tested off-site before being introduced to the camp. Apart from this peculiarity, the refitting results are not significantly different in relation to the various types of core

34 At the time of writing, systematic refitting has not yet been attempted at the isolated loci (Rekem 2 and 14). Note that the share of cores involved in refitting varies at the various loci, ranging from a limited success of about 1/3 at Rekem 12, and Rekem 6, to a participation of all the cores at the small locus Rekem 15.

Table 29
Rekem habitation zone 1. Cores involved in refitting at the various loci.

Refitting-type	Locus: 1	4	5	6	7	10	11	12	13	15	16	Total	%
In reduction sequence	13	4	16	13	7	9	11	5	2	5	3	88	46%
Reduction + break refit	4	-	2	2	2	2	3	-	-	-	4	19	10%
Break refit only	2	-	1	2	-	-	-	-	-	-	-	5	3%
Not refitted	13	5	9	26	4	3	2	11	2	-	4	79	41%
Total	32	9	28	43	13	14	16	16	4	5	11	191	100%
% of cores in reduction refits	53%	44%	64%	35%	69%	79%	88%	31%	50%	100%	64%	56%	

Table 30
Rekem habitation zone 1. Refitting results for various core types.

Refitting-type	Morphology (shape) of core								
	Prismatic	Pyramidal	Globular	Flat	Irregular	Broken	Tested block	Total	%
In reduction sequence	31	25	9	7	10	6	-	88	46%
Reduction + break refit	5	-	-	2	2	10	-	19	10%
Break refit only	-	1	-	-	-	2	2	5	3%
Not refitted	38	11	6	5	5	5	9	79	41%
Total	74	37	15	14	17	23	11	191	100%
% of cores in reduction refits	49%	68%	60%	64%	71%	70%	0%	56%	

shapes (Table 30) or with regard to the types of production (Table 31).

In all, the refitting evidence at Rekem strongly indicates that the large majority of cores had been discarded after at least some knapping on the spot. On the other hand, the occasional absence of cores in otherwise comprehensive reduction refits (*e.g.* at Rekem 5) points at the intentional export of these items. Raw material peculiarities conversely suggest that some cores (*e.g.* at Rekem 13) had been knapped elsewhere, transported to the site and discarded. The latter are often quite small. It is interesting to note that exhausted cores (*i.e.* items apparently discarded because of their reduced size, but which are otherwise undamaged) are far less frequently refitted (27%) than cores which had suffered from so-called knapping accidents. For the latter, the involvement of cores in debitage refits ranges from 64% for cores with hinging removals to 83% for cores discarded because of plunging flakes (Table 32). Although alternative explanations might be applicable (*i.e.* the impact of size in refitting results), we believe that at least some of the non-refitted, exhausted cores might represent specimens which had been kept during travel between sites for the occasional production of blanks on the way. These were eventually discarded after arrival at a (new) setting which was provided with sufficient raw material for their replacement.

4.5.5 Selection of blanks for tooling and use

Within the context of a habitation site, it may be postulated that flint knapping primarily served to generate blanks destined for tooling and/or use. It is therefore essential to ask two main questions:

1. What (if any) selection criteria have been adopted? In other words, what blanks were desired for tooling or use – what 'end products' were intended to result from the knapping process?
2. Is there any variety of preferences among the various tool types, and if so, was this correlated with specific reduction strategies?

Answering the first question is not as easy as it may seem. In fact tool-fabrication by definition implies the modification of a blank. The more a tool is used and resharpened, the less evidence it will retain of the original nature of its blank. Whether a short endscraper was initially made on a flake, a laminar flake or a blade is often hard to define from the tool itself, usually found as an abandoned specimen. For the identification of the original blank of the tools at Rekem, a somewhat different classification system has therefore been adopted, primarily based on the scar patterns on the dorsal face of the tools. Details are provided with the tool description in chapter 5.

In general terms, the classification suggests that a clear majority of the tools were made from blanks

Table 31
Rekem habitation zone 1. Refitting results for cores by type of production. (Tested blocks and most broken cores are not included.)

Refitting-type	Type of production					
	Blades	Bladelets	Lamin. flakes	Flakes	Total	%
In reduction sequence	39	13	27	5	84	52%
Reduction + break refit	5	1	3	2	11	7%
Break refit only	-	1	-	-	1	1%
Not refitted	25	10	23	8	66	41%
Total	69	25	53	15	162	100%
% of cores in reduction refits	64%	56%	57%	47%	59%	

Table 32
Rekem habitation zone 1. Refitting results for cores rejected for various possible reasons.

Refitting-type	Possible reason(s) for discard of cores: No obvious reason	Hinging removal(s)	Plunging removal(s)	Irregular. in flint	Broken	Size (exhaust.)	Hinging + irregular.	Hinging + size	Total
In reduction sequence	21	46	5	3	5	4	2	2	88
Reduction + break refit	5	3	-	-	9	2	-	-	19
Break refit only	-	-	-	1	3	-	-	1	5
Not refitted	28	27	1	1	3	16	-	3	79
Total	54	76	6	5	20	22	2	6	191
% of cores in reduction refits	48%	64%	83%	60%	70%	27%	100%	33%	56%

with more or less parallel edges and ridges, generally with a triangular or trapezoidal cross-section. A considerable number, *i.e.* between one fifth and a quarter of the tools, were made on blanks covered with cortex on more than one third of the dorsal face. Few tools (less than 10%) are made on trimming flakes or 'irregular' blanks. Interestingly, the proportions of cortical blanks and trimming products in the general inventory of debitage and rejuvenation products are broadly similar, *i.e.* about 20%, and 4% respectively (Table 13). In other words, products resulting from the early phases of knapping, or from core maintenance activities, were certainly not excluded from selection for tooling.

On the whole, and with lateral modified laminar pieces not taken into account, blanks 'consumed' during tooling activities were marked by great formal diversity. At Rekem, this lack of rigid selectivity can hardly be ascribed to a lack of raw material (as suggested for Meer II[35]). In our opinion, it rather complies with the general attitude adopted towards flint knapping and consumption by the *Federmesser* artisans. As was shown above, the presence of cortex did not at all bother the flintknappers, and rejuvenation products did not appear to have had a specific status. Again, remarkable flexibility seems to have governed the selection of blanks.

On the other hand, lateral modified laminar pieces, by definition, exclusively exploited the laminar products, although selection criteria were again not totally inflexible. It seems that a certain preference also existed for elongated elements in other tool categories but this tendency is by no means clearcut. For scrapers, for instance, the proportions of scrapers on blade (29%) versus scrapers on flake (71%), shows in fact no other pattern than the one observed in the general inventory of the debitage products (Table 13).

As argued above, the true dimensions of the original blanks have been obliterated by the modification processes. Refitting could help here in the following circumstances: 1) refitting of (re)sharpening flakes (and fragments) could occasionally lead to a reconstruction of the original blank (in practice, this was so far only possible with burins; *e.g.* Pl. 89: 3,4); or 2) refitting of the tool in its original context of the reduction sequence could make its initial form visible on the negative removals of the 'neighbour' blanks (possible with all tool categories; *e.g.* Pl. 75; Pl. 99). At Rekem, this provided the results shown in fig. 33.

[35] Van Noten 1978, 34.

33 *Rekem 1984-86. Dimensions of original blanks of various tool types, reconstructed by refitting.*

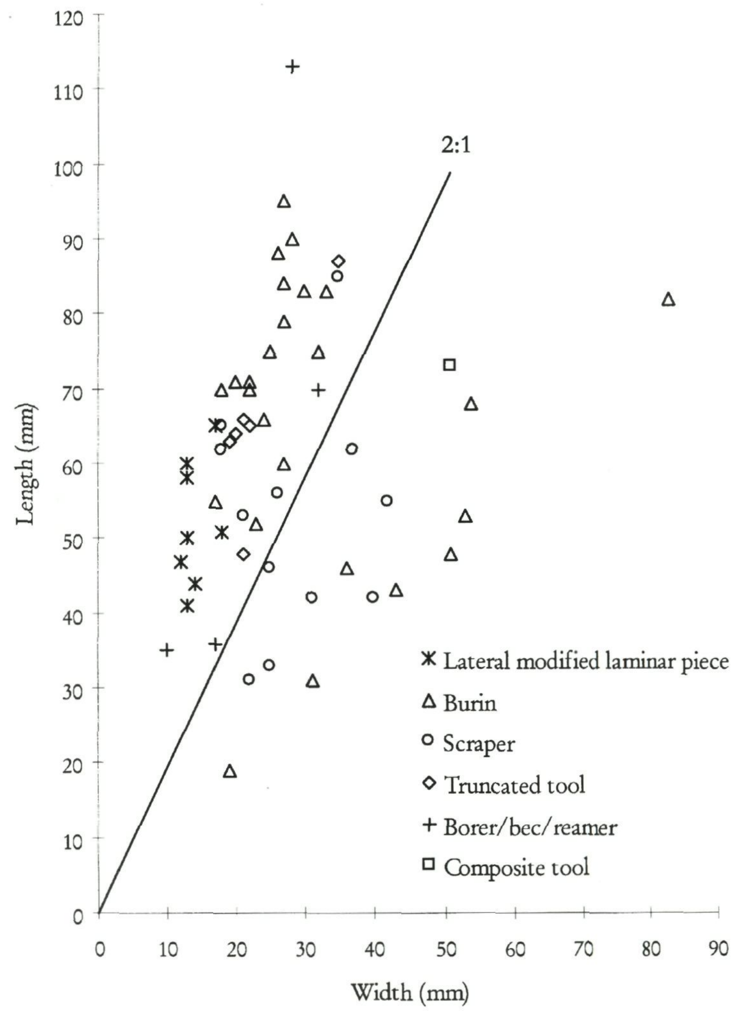


Table 33
Rekem habitation zone 1. Use wear traces observed on unmodified artefacts included in the refits (edge-damaged pieces excluded).

	Artefact type					
	Flake	Laminar flake	Blade	Core	Lump	Total
Total number	843	198	576	112	86	1815
Total number analysed	437	146	481	16	2	108
N suited for microwear determination	413	138	446	15	0	1012
N with usewear traces	2	5	8	0	0	15
% with usewear traces	0%	4%	2%	0%		1%
Action and contact matter:						
Butchering	-	3	-	-	-	3
Cutting soft animal matter	-	1	1	-	-	2
Scraping hide	-	-	1	-	-	1
Cutting hide	1	1	1	-	-	3
Sawing bone/antler	-	-	3	-	-	3
Butchering + sawing bone/antler	-	-	1	-	-	1
Sawing wood	-	-	1	-	-	1
Fire-lighter	1	-	-	-	-	1

In dimensional terms, more than two thirds of these tools (40/56) appeared to be made on blades (L>2W), a ratio that is not at all compatible with the general inventory of artefacts (Table 13). Altogether, the refitted reduction sequences show that, on average, nearly 1 blade out of 4 was modified into a tool, while less then 1 flake out of 12 was selected for tool production. Laminar flakes are situated in between, but tend towards the blades. These differences must not be ascribed to the refitters' impact, as refit rates for flakes and blades were on the whole quite similar. Therefore, the results can truly be seen as a reflection of the actual choices made by the toolmakers.

Once again, differences appear when the tool types are considered separately. Though the number of reconstructed LMP blanks is limited, an outspoken preference for narrow blades (somewhere between 13mm and 18mm wide, and 40 mm to 60mm long) seems to exist. Burins were also preferentially made on blades (17/25), though certainly not exclusively. Burin blanks are mainly characterised by their large size. Scrapers, to the contrary appeared to be made on flakes (7) rather then on blades (5). The other tool types are only minimally represented (fig. 33).

The variation observed for the various tool types, automatically leads to the second question posed above: were reduction strategies modulated to obtain a specific output for different tool classes? Or in other words, did a quest for specific tool types or functions, predetermine the mode of the knapping projects?

The hidden assumption in this question, namely that the knappers started a reduction when specific tool types were needed, seems to be generally justified at Rekem. When a series of tools could be refitted into a sequence, the implements were mostly of the same type, or at least of 'related' types (*e.g.* burins and truncations; see chapter 5). Examples can be found, for lateral modified laminar pieces, on (co)sets 01c05, 05s109, 06s68 & 07c06, for burins on (co)sets 01c01, 05c03, 05c12, 05c22, 05s64 & 06s54, for scrapers on sets 05s91, 05s95 & 16s18, and for truncations on set 01s42. Precise raw material similarities suggest that even more series of cognate tools were struck from a single nodule (see also chapter 6). On the other hand, combinations of different tool types in a single sequence are not fully absent (*e.g.* 05c05, 05c08, 05c14 & 07c08). Occasionally different tool types seem to have co-operated in the same task (*e.g.* scrapers and burins of 05c05 & 05c14). Conversely the combinations might be explained by the fact that locally deposited blanks were being 'recuperated' during other activities (*e.g.* the burin in the 'scraper co-set' 05c08). In yet other examples, the combinations remain somewhat enigmatic but reveal a selection of different blank types (*e.g.* crested blades for burins, and regular blades for lateral modified laminar pieces, in co-sets 07c06 & 07c08). This topic is discussed further in chapter 6.

The main concern here, however, is that, in spite of the apparent 'motivated' reduction with regard to the fabrication of tools, we could not find truly significant evidence to demonstrate that the production of supports for specific tool categories was guided by particular reduction methods[36]. The only overall manifestations are that tools as a whole were mainly found in rather skilfully reduced sequences processed on good quality flint nodules and that a tendency existed towards selecting the larger pieces of the output (cf. 11c04). Tool manufacturers were on the whole also inclined to favour the more regular laminar prod-

[36] Because of the scarcity of refitting backed points and backed bladelets, it cannot (yet) be fully asserted that these conclusions are also valid with regard to lateral modified laminar pieces.

ucts for tool fabrication. On the other hand, it should be stressed that when pieces that technically belonged with the preparatory products of the reduction were fabricated into tools, the most regular blanks of the same co-sets were often plainly ignored (*e.g.* 01c01, 05c03; Pl. 21; Pl. 32-34). In addition, blades from reduction sequences with rapidly inverted debitage directions, which produced the most regular blades, were generally left unmodified. Microwear analysis has demonstrated, however, that some of these specimens were selected for utilisation without any further modification (*e.g.* as butchering knives in case of co-sets 05c09 and 05c17).

In all, 15 unmodified artefacts included in the refits of habitation zone 1 and subjected to microwear analysis, carry microscopic traces of use (Table 33). They are mostly blades or laminar flakes, although 2 flakes also appeared to have been selected for use. These unmodified blanks chiefly served for butchering, or on soft (hide, tendons, meat) or hard animal matter (bone/antler), or on wood. One blade was also employed in hide scraping activities, and a final piece was presumably used as a strike-a-light.

On the whole, the refitting work confirmed that while a preference existed for laminar elements, selection criteria were not rigidly adopted when blanks were chosen for tooling. The blank/tool relationships at Rekem and the comparisons with other Late Palaeolithic industries in NW Europe are discussed further in chapter 5.

4.6 Discussion and conclusions

The combination of a detailed, techno-morphological examination of the artefacts combined with the insights obtained from extensive refitting have provided a clear picture of the flint technology at Rekem. Further discussion and some comparisons with Late Palaeolithic assemblages that have been equally subjected to detailed technological analyses are drawn below.

4.6.1 An adaptable lithic technology

The ever-recurring theme in the overview presented above, seems to be the flexibility adopted by the flint knappers at Rekem throughout the entire knapping process.

First of all, a lack of consistency could be perceived in the procurement strategy. Quality, size, and shape of the original flint nodules appear to be highly variable. It seems that these people were not too much concerned with real 'selection' procedures, but rather exploited a wide range of raw materials. This observation contrasts significantly with the strategy adopted by the Magdalenians at nearby Kanne, who intentionally searched for large good quality flint nodules[37]. For both Kanne and Rekem, however, flint was of (sub-)local origin, and lithic raw material determination therefore can hardly contribute to a perception of the territories traversed by these groups.

In the Neuwied Basin (Germany), on the other hand, investigations of lithic raw materials have shown that the scale of the territory exploited by the *Federmesser* groups was in fact very similar to that of the Magdalenians, covering distances of up to 100km away from the site[38]. The strategies employed in the procurement of raw material, however, appear to have been somewhat different[39]. Certain Magdalenian lithic assemblages are dominated by large quantities of exogenous flint with specific origins, essentially imported as pre-struck blade blanks and preformed cores, which suggests intentionally structured procurement. The exogenous lithics on *Federmesser* sites, however, generally constitute a small volume of heterogeneous materials, possibly representing a portable reserve collected by the group(s) over a period of time during stays in various regions.

At Rekem the latter phenomenon may be reflected in the scarce presence of translucent, very homogeneous dark brown fine-grained flint with a white-yellow (pseudo-)cortex (type 4; section 4.2.2). This flint type has also been found at most other *Federmesser* sites in the region, but its exact provenance remains unsettled. Origins as far apart as Obourg (Hainaut, Belgium) or the North Sea Basin, have been claimed[40].

It has long since been observed that post-Magdalenian industries became increasingly satisfied with inferior qualities of raw material. In connection with the distinctive procurement systems, it is clear from the evidence in the Rhineland that the Magdalenian strategy demonstrates selection for, and rational use of, good-quality flint, whereas the less-rigid pattern of lithic raw material procurement of the *Federmesser* groups manifests a low priority on quality. In Northern France, the shift to decreasing selectivity has been noted during the transition from the initial to the recent phase of the *Federmesser* occupation[41]. Whereas the former, like the Magdalenians, extracted good quality flint out of the resources at the Valley bottoms, later *Federmesser* groups opportunistically collected smaller cobbles of slightly inferior quality on the surface. Such evolution has often been ascribed to the increasing difficulties in accessing the appropriate resources, partially induced by a developing vegetation cover[42]. An explanation which puts less weight on environmental determinants but instead rather stresses the deliberate (cultural) choices of the artisans, might be found in the simplification of the debitage methods in the *Federmesser* industries. Increasing flexibility in knapping practice may have released the artisans from the more exacting demands of Magdalenian lithic technology and allowed them to exploit a more diversified range of lithic raw materials[43].

37 Vermeersch *et al.* 1985.
38 Floss 1994.
39 Baales & Street 1996.
40 Van Noten 1978, 34; Wouters 1984, 74; Arts 1988, 293.
41 Fagnart 1997.
42 Stapert 1979; Vermeersch 1984.
43 Valentin 1995; Bodu & Valentin 1997.

A high degree of flexibility has indeed been observed at Rekem. The 'simplified blade technology' was governed by the constant adaptation to the shapes of the volumes. Careful preparation, which is normally desired in order to obtain regular blades without wasting flint, was but rarely applied. As such, we fully agree with the conclusions of B. Valentin[44] for the contemporaneous *Federmesser* site of Ambenay-Le Cornet, in the Paris Basin that *'dans la plupart des cas, mise en forme et initialisation du débitage se confondent'*.

In overall diachronic terms, it seems that the diligent preparation and shaping out of the cores gradually receded after the elaborate pre-forming of the knapping volumes had somehow reached their culmination in the sophisticated blade technology of the Magdalenian (see section 4.3.4). In part, the lack of a clear separation between the processes of preparation and of 'full debitage' in *Federmesser* technology, may probably be ascribed to the uninterrupted use of stone hammers. With this practice, cores could be continuously maintained in the course of the reduction. The separate use of an organic hammer during the *'plein débitage'* (blade production), as was the case in the Magdalenian industries, may have stimulated the knappers to take special care during the initial hard hammer shaping of the cores[45]. This alternation of hammer types also partly explains the obvious dichotomy between flakes and blades in the Magdalenian. At Rekem, a clear bimodality between blades and flakes is lacking precisely because the blade and flake categories are bridged by the characteristic 'laminar flakes' group.

In a wider perspective, the transition from Magdalenian to *Federmesser* knapping traditions was probably gradual (*i.e.* a process rather than an event). Recently, this gradual technological change could be clearly established in Northern France[46], the Paris Basin[47], and in the more Southern Azilian assemblages of Bois-Ragot (Vienne) and Pont d'Ambon (Dordogne)[48]. In all these regions, the process of 'Azilianisation' was apparently triggered by the systematic use of soft stone hammers during blade production (*'plein debitage'*), a practice which seems to be introduced slightly before the beginning of the *Alleröd*. In the course of this further evolution, a gradual shift transpired from regular blade debitage with a careful preparation of the working volume and striking platforms (abrasion and facetting), to a more versatile technology with a less rigid laminar intention (as at Rekem).

A similar gradual evolution from the Magdalenian and related industries to the *Federmesser* technological tradition in the more Northern areas of Western Europe has not yet been fully demonstrated, though some indications seem to be emerging. At the (presumably) intermediate industry of Hengistbury Head (Great Britain), for instance, the distinction between blades and flakes seems still quite clear-cut[49]. Other differences at Hengistbury Head, as compared with Rekem, are the somewhat more systematic organisation of the debitage[50], a distinct preparation of the (opposed) platforms, and elaborate cresting (frontal and dorsal). Profound platform abrasion (heavy grinding) and higher productivity (more blades, but also bigger nodules) are further characteristics of the Late Palaeolithic technology at this site, as distinguished from the technological appearance of more recent Final Palaeolithic industries (associated with recent *Federmesser* groups on the continent[51]).

In the Benelux, a possible older phase of the *Federmesser* occupation has so far remained undistinguished. Although some technological variability may be discerned across the *Federmesser* assemblages of this region, hitherto, no adequate (diachronic) seriation could be established. The possible role in this process of the late Hamburgian as well as of the so-called Creswellian in the Netherlands remains equally unestablished (see also section 1.2.2). No doubt, useful work remains to be done in this direction.

The existence of a *'débitage laminaire classique'* (as opposed to the *'débitage laminaire simplifié'*), claimed for the *Federmesser* site of Meer II[52], with associated inferences of *'artisans spécialisés'*[53], could not be diagnosed at Rekem. As a matter of fact, one could question their existence in the *Federmesser* assemblage of Meer II as well, since the claim of a 'classical blade debitage' at this site appears to be based on limited evidence (essentially on two reconstructions). In one case, moreover (a production of bladelets[54]), a possible Mesolithic admixture seems not to be fully excluded. In addition, the interpretation is mainly based on negative evidence, i.e. situated 'outside the excavation'[55]. All in all, we are not inclined to believe that elaborate 'classical' blade debitage, performed by specialists outside the living sites, was a systematic practice in the recent phase of the *Federmesser* technological tradition (see also section 4.6.2). At Rekem at least, tools (or their blanks) were mostly knapped as required, though occasionally some 'recuperation' of previously made blanks may have occurred (see for further discussion also chapter 5 and chapter 6).

4.6.2 A variety of knapping skills

Much of the recent work of (French) lithic technologists studying the Late Upper Palaeolithic, has been concerned with identifying the technical skills

44 Valentin 1995, 506.
45 Cf. Valentin 1995, 514.
46 Fagnart 1997; Coudret & Fagnart 1997.
47 Valentin 1995; Bodu & Valentin 1997.
48 Célérier, Chollet & Hantaï 1997.
49 Cf. Barton 1992, 100: *'Another divergence is in the frequent occurrence of cortex on flakes, a feature not shared by the blades since fewer of these come from the initial stages of core preparation.'*
50 Cf. the description of core A in Barton 1992, 139.
51 Barton & Roberts 1997.
52 Cahen 1978; Cahen *et al.* 1980, 217.
53 Cahen *et al.* 1980, 218.
54 Van Noten 1978, pl. 43.
55 Cf. Cahen *et al.* 1980, 218: *'A Meer, la préparation des lames n'a pas, pour l'essentiel, été effectuée dans l'espace fouillé'*.

of individual prehistoric knappers[56]. In fact, the high-quality blade production of Magdalenian technology obviously involved an extensive learning process, giving rise to individuals with distinct levels of knapping competence. At Etiolles, this hierarchy was also reflected in the socio-economic organisation of the lithic technology[57]. The larger original nodules of good quality were reserved for the highly experienced knappers. There was also a social division of space dependant on the skills of the different technicians (skilled and elaborated manufacture at the centre, close to the hearth, more simplified knapping slightly behind, and clumsy attempts still further along the edges of the habitation[58]). At Pincevent, the 'attractive' blades and bladelets produced by the most competent knapper(s) were also widely transported all across the camp area or, indeed, away from it[59].

At Rekem, the overall differences in knapping quality suggest that workers with divergent technical skills operated as well. In very general terms, 3 gradually diverging levels of technical quality may be distinguished:

1. Well-elaborated reduction sequences, with appropriate shaping out and maintenance of the core, generating a considerable output of regular laminar products, which were often selected for tooling and/or use (*e.g.* co-sets 01c01 part c, 05c05, 05c08, 05c20, 10c02). Occasionally, a particularly rich output of regular blades was equally obtained with an efficient bipolar extraction, lacking intensive core preparation (*e.g.* 05c09, 05c17, 16c02).
2. Simple debitage, seemingly lacking a preconceived scheme, but still arriving at a limited production of adequate blanks by a flexible adaptation to the volume being worked. The description applies to the large majority of the industry.
3. Unorganised rudimental debitage, lacking any conceptual scheme, and generating thick hinging flakes that rapidly devastated the core. No economic output (*e.g.* co-sets 05c16, 11c06).

However, due to the overall basic level of technicality and the apparent lack of rigid procedural templates, differentiating individual knappers remained a fairly conjectural approach. Certain problems for this classification, generally related with the ambiguity of the criteria, have been advanced above (section 4.4.1.4). On top of that, it cannot be excluded that (part of) the variability may be explained by other factors such as divergent knapping objectives for different sequences, a certain diachrony for inter-locus variability (section 4.6.3), etc.

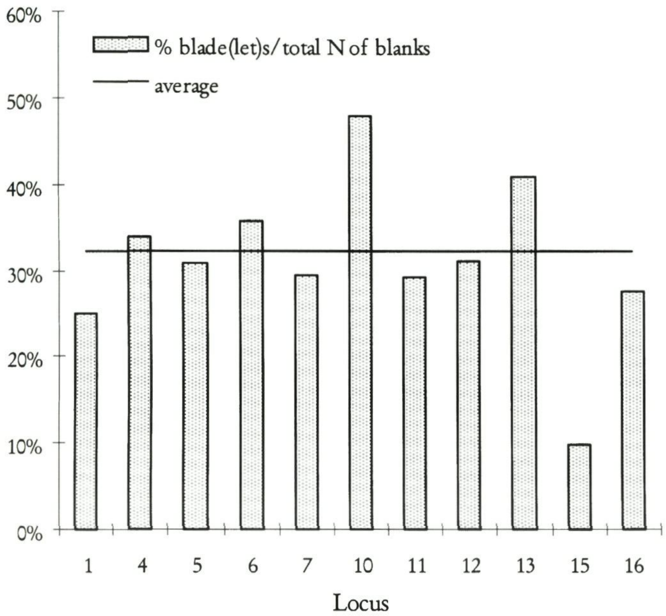
In any case, none of the correlations demonstrated for the Magdalenian could be clearly observed at Rekem. While a certain relationship could be found between the size and quality of the original nodule on the one hand, and the quality of knapping (output), on the other, at Rekem this should not necessarily be interpreted as a sign of the efficient management of lithic raw materials. Obviously, small, poor quality flint nodules simply did not allow for elaborate laminar production. Conversely, it seems that certain large, good quality nodules were sometimes inefficiently exploited (rather 'destroyed') by inappropriate knapping (*e.g.* 01c07, 05c16, 06c06, 11c02, and as a particular case 16c01, the biggest nodule of the entire site, which was apparently wasted into thick, irregular flakes[60]).

As for the spatial distribution of the various gradations in knapping quality, no systematic patterning could be revealed either[61]. At the small Eastern loci of habitation zone 1, the quality of knapping generally exhibits little variation – possibly very few knappers were present[62] – and knapping posts of the various reduction sequences were either superimposed, or situated next to each other, eventually leading to a single cluster of artefacts. At the large western loci, on the other hand, the debitage of the various blocks generally occurred at discrete locations, but fixed areas for high-quality versus low-quality knapping sequences could not be demarcated. For instance, at Rekem 5 West, a 'high-quality' sequence and two low-quality sequences were situated respectively on the S, the E, and the W side of the hearth. These areas are represented by 05c17, which demonstrates an adequate production of well-shaped blades which seem to have been essentially exported, and 05c02 and 05c16 which are both representative of clumsy handicraft with no economic productivity. At Rekem 5 East, on the other hand, the position of the knappers was essentially determined by the location of other ongoing activities (see chapter 6). Finally, inside the hypothetical dwelling of Rekem 10 the knapping positions can be hardly delimited, especially for the most refined sequences (10c02 and 10c06) of which the products are widely scattered inside the dwelling.

All in all, at Rekem, the possible social aspects (specialisation, apprenticeship, hierarchies etc.) that may have guided flint knapping, unfortunately remain merely undistinguished. We fully recognise that simple technologies may have also been subject to social control (for example they may have been integrated into value systems and thus have been endowed with symbolic significance[63]). However it is, nevertheless, our overall impression that flint knapping in this *Federmesser* tradition was a fairly elementary practice of domestic rather than of pres-

[56] *e.g.* Pigeot 1987; Ploux 1989; Bodu *et al.* 1990; Bodu 1993.
[57] Pigeot 1987.
[58] Pigeot 1990, 132.
[59] Bodu 1996.
[60] Modern flintknappers generally agree that difficulty in knapping increases exponentially with the dimensions of the worked materials. It seems quite possible, therefore, that the artisans at Rekem simply could not accurately exploit a block of 30cm in length.
[61] These aspects are mainly discussed in chapter 6, and we will therefore stick to some general observations here.
[62] At some small loci, it can even be suggested that the output was essentially generated by a single knapper. At Rekem 15, for instance, co-sets 15c01 and 15c02 are remarkable 'twins'; the reduction was organised in an identical way, and the cores were left in a very similar state. Recurring 'styles' of knapping could occasionally be observed at other loci as well.
[63] Pigeot 1990, 138.

34 *Rekem, habitation zone 1. Ratios of blades and bladelets at the various loci.*



tige character. It appears to have been virtually lacking in more transcendent connotations. As the combination of refitting, use-wear and spatial analyses shows, the essential goal of this technology was clearly to serve immediate utilitarian purposes, *i.e.* the fulfilling of basic (personal?) needs. From this perspective, it seems likely that technical know-how was also widely distributed among members of the group, or that flint knapping experts – if present – hardly enjoyed special privileges. In fact, it is likely that a possible techno-economical organisation of the *Federmesser* hunter-gatherer society into small, fairly autonomous, (residentially) mobile units[64], may have impeded a far- reaching development of individualised crafts specialisation.

[64] Baales & Street 1996, 309.

4.6.3 Inter-locus variability

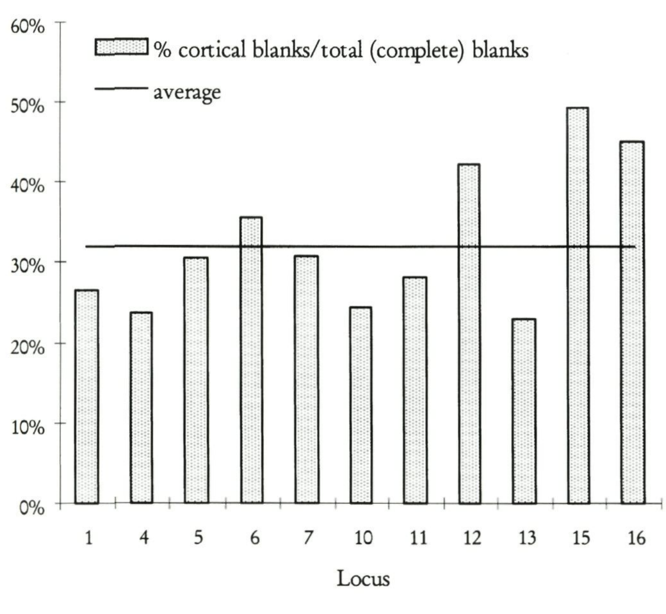
While the spatial differentiation inside the various units did not reveal any significant patterns of knapping quality, differences did emerge between the different loci of habitation zone 1.

Prominent dissimilarities can, for instance, be noted between the reduction sequences of the (presumed) dwelling at Rekem 10 on the one hand, and of the small knapping spot Rekem 15 on the other. All proportions considered, Rekem 10 shows a careful selection of raw materials, and an appropriate preparation of the cores. Crests, core flanks, and striking platforms were adequately maintained, and cores were intensely exploited (completely exhausted), generating a substantial production of rather thin, short blades and bladelets. Although a different, somewhat more robust debitage, not as well-organised and with less elongated products, could equally be observed at Rekem 10, this was on the whole still far more refined than the debitage at Rekem 15. At the latter locus, the refitting generated a different picture. The reduction sequences were poorly organised, generated numerous knapping accidents, and produced an extremely poor output of (laminar) cortical flakes, both in terms of quality and quantity. Evidence of proficient knapping experience is completely lacking here.

Obviously, the differences between those two extremes are also reflected in the general artefact inventories. Whereas at Rekem 10, more than 45% of the blanks are laminar products, this ratio represents less than 10% at Rekem 15 (fig. 34). Conversely, while almost half of the blanks at Rekem 15 are cortical, at Rekem 10 this accounts for less than a quarter of the specimens (fig. 35). Both ratios provide appropriate general characteristics of the debitage activities at these (and the other) loci, reflecting primary flaking at Rekem 15, and more elaborate, full blade production at Rekem 10. Finally, these differences are also expressed in the contrasting average sizes of the abandoned cores (fig. 36).

The consequences of this inter-locus variability, and possible interpretations for habitation zone 1 as a whole are further debated in the spatial analyses of chapter 6.

35 *Rekem, habitation zone 1. Ratios of cortical blanks at the various loci.*



4.6.4 The value of refitting in technological analyses

The merits of refitting as a heuristic tool in the studies of lithic technology have long since been recognised and acknowledged. The present work corroborates that even an advanced techno-morphological analysis of knapping waste alone, would have rendered a limited and sometimes even inadequate picture of the debitage technology at Rekem. This is particularly well illustrated by the confrontation of the detailed techno-morphological analysis of the cores with the dynamic analysis of the refitted sequences.

First of all, size and morphology of the original nodules selected for exploitation, and the degree of their reduction, could be hardly reconstructed without refitting.

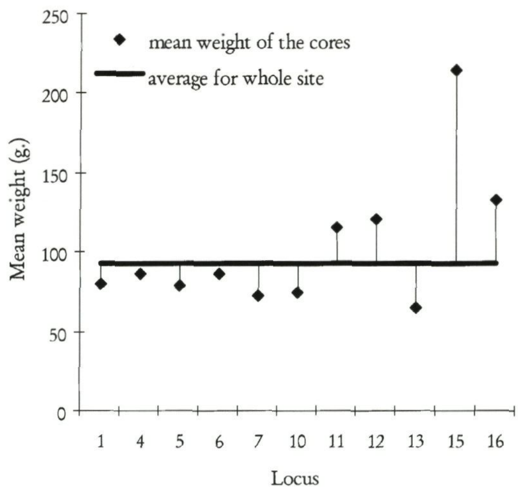
Second, refitting brought to light the observation that – except in case of rapid abandonment – the technical attributes of the cores did not necessarily reveal the actual manufacturing process applied. The initial shaping of the cores in particular was often obliterated by posterior reduction, as successive stages of the knapping sequence by nature remove traces of earlier exploitation. Evidence of lateral trimming, for instance, frequently observed in the refitted sequences, had been repeatedly erased from the abandoned core, by the posterior laminar exploitation of the flanks. The initial position of a crest on the core table (central or close to one of the edges), as well as its actual role in the sequence (*e.g.* displacement of 'natural' ridge, correction of flaking accidents etc.; section 4.5.2.2) could also only be reconstructed from the refitting analysis. Major divergences could equally be observed between the morphologically defined rejuvenation products, and the actual role they played in the reduction sequence. In fact, the latter information, *i.e.* where exactly flakes belong within a reduction process, cannot be read correctly from the inventory table. Only "re-fitting" it into its original context can provide information about the provenance, its contribution to the reduction process, and thus the original technological significance.

Also the character of the 'full debitage', however, could often not be reconstructed from the appearance of the abandoned core alone. The direction(s) of exploitation, for instance, could hardly be adequately inferred from the negative removals on the core tables or from the number of preserved striking platforms. In fact, refitting showed that the knapping direction repeatedly changed in the course of the reduction sequence, often without leaving any traces on the discarded core. It is obvious that only the act of refitting can highlight factors such as the rhythm of these changes, the actual output of single laminar generations and the precise successions of the various stages of the reduction sequence.

The type of production also cannot always be accurately inferred from the core table. Obviously, the gradual reduction of 'blade cores' results in an over-emphasis of abandoned core tables with traces of bladelet production. Of course, the actual production of a sequence, as well as its contribution in terms of economic output, and the possible association of tools, are also interesting results of the refitting procedure.

The causes of the abandonment of a knapping sequence, as inferred from the core analysis, could equally be fine-tuned by the refitting results. It appeared, for instance, that the plunging of blanks on the core table did not automatically lead to the rejection of a core, as knappers occasionally took advantage of the additional convexity created by heavy overpassing, or started exploiting the opposite side of the core. On the other hand, the hinging of flakes was confirmed as a cause of discard, as was the absence of useful ridges on globular specimens.

36 *Rekem, habitation zone 1. Mean weight of the cores at the various loci.*



It is likely that the information obtained from a static analysis of the knapping waste on the one hand, and from refitting on the other, will show more explicit discrepancies in a lithic assemblage that has an extremely flexible debitage (like Rekem) than in an industry with a more strictly organised, recurrent and uniform technology (like Kanne).

Finally, it should be stressed that the refitting evidence made a considerable contribution in the reconstruction of tool use lives (chapter 5) and in the spatial analysis (chapter 6).

4.6.5 Prospects for inter-assemblage comparisons and regional studies

In the past, repeated attempts have been set up to classify the *Federmesser* sites of NW Europe into regional groups, called 'Tjonger', 'Rissen', 'Wehlen', 'Witow', etc.[65]. Whereas some authors still seem to adhere to these groupings[66], the accuracy and meaning of these classifications have since long been questioned by others[67]. One of the main concerns in those critiques – beside the fact that partitioning was often based on a sample of surface collections or partly excavated sites – is that the traditional schemes were almost exclusively built on typological comparisons of the lithic tools. Next to general, theoretical objections toward such a monothetic approach, it has been demonstrated that tool variability in a *Federmesser* context, both in quantitative and qualitative terms, seems to be affected by a particularly wide

[65] Schwabedissen 1954; Bohmers 1956; Taute 1963; Campbell 1977.
[66] Otte 1994, 43.
[67] Paddayya 1971; De Bie 1988; Houtsma *et al.* 1996; see chapter 1.

range of parameters[68]. In any case, there can be no doubt that inter-site comparisons of *Federmesser* assemblages would be enhanced if an additional aspect (*i.e.* debitage technology) could equally be taken into consideration. As stated above, being only indirectly related to function, knapping technology is supposedly a good indicator of socio-cultural affinities.

Recent investigations in Northern France[69], and the Paris Basin[70], have shown that comparative technological analyses can indeed be fruitfully applied to establish diachronic developments across the *Federmesser* industries. The potential of such an approach for (synchronic) inter-regional studies, however, remains to be demonstrated. First, it will always be difficult to define the precise impact on the lithic production, of the variegated availability and the quality of raw materials in different regions (*e.g.* poor in the Neuwied Basin in Germany, *versus* rich in Northern France). As was shown in our analysis, *Federmesser* artisans at Rekem, in fact thoroughly adapted their flint knapping projects to the form and quality of the raw material[71]. Next, although the identification of individual knappers in a *Federmesser* site appears to be difficult, the presence of different levels of knapping quality, and a variety of knapping 'styles' can be clearly demonstrated. It would not surprise us if the intra-site variability in this respect potentially exceeds the inter-assemblage variation. Finally, the general inclination towards the simplification and extreme flexibility of the *Federmesser* flint technology, with a gradual disappearance of rigid knapping schemes, further hampers a credible disclosure of possible regional facies of the *Federmesser* industries on this basis.

In spite of all this, however, it is our hope that some of the particularities expressed in the knapping projects of the Rekem artisans, as described in this chapter, may one day prove to be significant 'cultural' features of a well-defined facies of the *Federmesser* groups. Clearly, much more comparable work will be needed before any such conclusions might eventually be reached.

[68] De Bie & Caspar 1997; see also chapter 5.
[69] Fagnart 1997.
[70] Valentin 1995; Bodu & Valentin 1997.
[71] In one case (12c01), it seems that a single flint knapper adopted a different reduction system on two parts (B and D) of a single block, given the different original morphologies of the chunks.

5 ‘Consumption’ of blanks: tool manufacture, use, maintenance, and... typology

5.1 Introduction and general inventory

5.1.1 Goals, methods, approach

The aims of this chapter are threefold. Firstly to describe the metrical, morphological, technological, and functional attributes of the various tool classes represented amongst the flint artefacts. Secondly to disclose significant characteristics and to explain these observations in terms of functional, technological, spatial, and/or stylistic variability. Thirdly and finally to compare the results between the different units (by referring to the spatial analyses of chapter 6), and with other sites when possible. In short, this chapter presents a blend of typology, attribute analysis, refitting, microwear analysis, and spatial analysis, aiming at a far-reaching decipherment of the flint tools from Rekem.

During the general descriptions of the various types of tools, for comparative purposes we primarily considered some aspects that have been emphasised in recent publications on Late Palaeolithic industries[1]. Equally, however, additional observations are discussed whenever they demand explanation or when they seem (potentially) significant for future analyses.

The macroscopic techno-morphological description (*i.e.* the ‘static approach’) is further systematically confronted with the results of the microwear analyses, and with the insights obtained from refitting. The combination of these analyses allows us to discuss the use-lives of various type of tools in a ‘dynamic approach’ (tool-biographies), which, eventually, will also be considered on a spatial level (chapter 6).

[1] Such as Bolus 1992; Barton 1992; Célérier 1992; Schmider s.d.; Fagnart 1997; Leesch 1998.

Table 34
Rekem 1984-86. Distribution of flint tools, tool waste, and edge-damaged artefacts at the various loci.
* retouch flakes not included.

	Locus															
Tools	1	2	4	5	6	7	8	10	11	12	13	14	15	16	Total	%
Lateral modified laminar piece - slender	38	4	2	85	49	19	-	40	17	29	1	11	-	2	297	30%
Lateral modified laminar piece - large	10	-	-	12	5	20	-	1	12	4	-	2	-	-	66	7%
Burin	27	6	6	85	53	2	-	47	20	13	-	7	2	6	274	28%
Scraper	10	2	1	58	41	5	3	6	7	19	-	6	-	12	170	17%
Truncated tool	21	-	2	10	16	7	-	7	3	2	-	3	-	5	76	8%
Borer/bec/reamer	2	-	-	15	8	-	-	10	1	2	-	1	-	2	41	4%
Composite tool	2	-	-	5	3	1	-	4	1	1	-	2	-	1	20	2%
Other retouched piece	3	2	-	11	4	1	1	7	1	1	1	-	-	1	33	3%
Total N tools	113	14	11	281	179	55	4	122	62	71	2	32	2	29	977	100%
%	12%	1%	1%	29%	18%	6%	0%	12%	6%	7%	0%	3%	0%	3%	100%	
Edge-damaged piece	35	2	0	107	36	12	4	30	18	38	4	0	0	16	302	
Total N of pieces with intentionally or accidentally modified edges	148	16	11	388	215	67	8	152	80	109	6	32	2	45	1279	
Krukowski microburins	7	-	-	4	-	17	-	1	9	4	-	-	-	-	42	
Burin spalls	28	4	1	141	65	1	-	44	36	28	1	-	1	10	360	
Total N tool waste*	35	4	1	145	65	18	0	45	45	32	1	0	1	10	402	

Table 35
Rekem 1984-86. Weight (in g.) of flint tools, tool waste, and edge-damaged artefacts at the various loci.
* retouch flakes not included.

	Locus															
Tools	1	2	4	5	6	7	8	10	11	12	13	14	15	16	Total	%
Lateral modified laminar piece - slender	41	3	1	64	36	23	-	24	11	25	1	9	-	2	240	4%
Lateral modified laminar piece - large	21	-	-	30	14	50	-	3	32	10	-	1	-	-	161	3%
Burin	392	106	72	819	379	24	-	289	211	111	-	133	15	110	2661	45%
Scraper	63	58	8	396	422	29	21	51	57	148	-	31	-	96	1380	23%
Truncated tool	167	-	13	59	175	82	-	35	33	19	-	10	-	40	632	11%
Borer/bec/reamer	4	-	-	32	21	-	-	24	1	15	-	9	-	4	110	2%
Composite tool	16	-	-	29	25	28	-	51	5	14	-	9	-	4	181	3%
Other retouched piece	61	26	-	126	109	43	29	45	23	2	39		-	10	514	9%
Total weight of tools	765	193	94	1555	1181	279	50	522	373	344	40	202	15	266	5879	100%
%	13%	3%	2%	26%	20%	5%	1%	9%	6%	6%	1%	3%	0%	5%	100%	
Edge-damaged piece	643	24	-	1624	543	201	58	383	221	551	65	-	-	309	4622	
Total weight of pieces with intentionally or accidentally modified edges	1408	217	94	3179	1724	480	108	905	594	895	105	202	15	575	10501	
Krukowski microburins	9	-	-	5	-	21	-	1	11	3	-	-	-	-	50	
Burin spalls	27	1	1	77	35	1	-	31	30	25	2	-	0	21	251	
Total weight of tool waste*	36	1	1	82	35	22	0	32	41	28	2	0	0	21	301	

A major effort has been made to identify the place of production of the various tool blanks. Systematic analysis of dorsal-ventral refitting results and of specific flint types by locus (see chapter 4) has enabled us to some extent to locate the origin of the blanks, even for certain series of unrefitted artefacts[2]. Clearly these determinations are qualified with varying degrees of certainty. This is also reflected in the description of the various situations that could be distinguished:

1. Refitted in a local reduction sequence including debitage waste material.
2. Unrefitted, but debitage waste material of this specific flint type is refitting at the locus.
3. Unrefitted, but member of a specific flint type including non-refitting debitage waste material at the locus.
4. Refitted in a dorsal-ventral refit lacking debitage (*i.e.* only with other tools).
5. Unrefitted and member of an unspecified flint type.
6. Unrefitted member of a flint type lacking debitage waste material.
7. Refitted with artefacts from another locus.

[2] These analyses were only performed for the loci of habitation zone 1. The tools of Rekem 2 and Rekem 14, both outside habitation zone 1, are integrated in the typological and functional analyses, but refitting and determination of specific flint types of these loci are still under examination. Rekem 2 and Rekem 14 are therefore not included in the tables presenting the origin of the tool blanks.

Table 36
Rekem 1984-86. Microscopic condition of all tools, tool waste, and edge-damaged pieces subjected to microwear analysis.
* burnt pieces not considered

	Type						
	LMP		Burin	Scraper	Truncated	Bec/borer/	Composite
Condition for microwear	Slender	Large			tool	reamer	tool
Non-altered	170	48	183	114	64	30	16
Weak mechanical alteration	28	2	24	9	1	3	-
Medium mechanical alteration	26	3	32	12	2	4	3
Strong mechanical alteration	15	4	29	15	3	2	1
Patined	1	-	1	-	-	-	-
Burnt	57	9	5	20	6	2	-
Total	297	66	274	170	76	41	20
% altered*	29%	16%	32%	24%	9%	23%	20%
% burnt	19%	14%	2%	12%	8%	5%	0%

The interpretation of this classification with regard to the origin of the tool blanks (*i.e.* their production place) is as follows. For tools of groups 1, 2, and 3, the origins are considered 'local', *i.e.* blank production likely occurred on the same spot. However, when debitage waste in those cases is limited to just a few artefacts, their production place may still be located away from the locus ('extra-local'). These situations are specified in the text. The production place of members of group 4 cannot be determined from refitting alone, but in the tables, this group is always accompanied by at least one of the other types (*e.g.* belonging to group 2 and group 4 makes '24'; same for '54', '74', etc.). For group 5, the origin of the tool blanks has also not been determined (can be local or not). Some specifications occur in the text. Finally, for groups 6 and 7, the fabrication of the tool blanks was clearly extra-local (unless, of course, the piece was knapped locally from a prepared core that was taken away again after site abandonment).

It should be noted that 'local production' in this stage of the interpretation also includes the occasional recycling of blanks knapped earlier but 'consumed' on the same spot in a later stage of occupation. Details of this situation are provided in the text (especially in the spatial analysis of chapter 6).

The results of the sequential refitting ('debitage') have been discussed in the previous chapter, but they proved to be relevant for the discussion on tool uselives as well. Refitting of tools with tool waste was also quite successful, but was provisionally mainly restricted to the conjoinment of burin spalls to burins and of Krukowski microburins to lateral modified laminar pieces. At the time of writing, there has been no systematic attempt to refit other retouch waste to tools, although such conjoins were occasionally made.

The lithic tools in this chapter are primarily viewed as need-responsive objects[3], which perfectly complies with the general aims of this work. However, the idiosyncratic character and stylistic potential (both for intra- and inter-site comparisons) of the various type of tools equally deserves extensive consideration.

Other retouched	Edge-damaged piece	Type Krukowksi microburin	Burin spall	Total	%
22	228	37	189	1101	71%
4	10	-	3	84	5%
1	30	1	12	126	8%
4	22	1	7	103	7%
-	-	-	-	2	0%
2	4	3	27	135	9%
33	294	42	238	1551	100%
29%	21%	5%	10%	22%	
6%	1%	7%	11%	9%	

5.1.2 General tool inventory

At Rekem, all common *Federmesser* tool types are present. The three major categories are lateral modified laminar pieces (points, blades, and bladelets; N=363), burins (N=274), and end-scrapers (N= 170). Their relative importance varies considerably at the different concentrations (Table 34). We shall argue that this variability is mainly re-lated to functional and contextual aspects. Numerically less important are truncated tools (N=76), borers, becs, and reamers (N=41), composite tools (N=20), and 'randomly' retouched pieces (N=33). In all, 977 intentionally modified flint tools were counted before refitting and had a total weight of 5879g (Table 35). Another 302 artefacts are considered to be non-intentionally modified edge-damaged pieces and are discussed separately. Finally, this chapter will also deal with the 42 Krukowski microburins, and the 360 burin spalls.

As discussed in chapter 1, the flint material at Rekem is hardly affected by chemical or physical alteration and is generally well preserved for microwear analysis. Moreover, on microscopically altered pieces, wear traces can often still be recognised. The microscopic condition of the various type of tools and tool waste products is shown in Table 36. The functional results will be discussed separately for every tool class.

Almost a quarter of the tools could be used in the refitting. There is, however, considerable variance by type of tool and by locus, ranging from 10% for slender LMP to 41% for burins, and for the larger tool assemblages, from 10% at Rekem 6, to 36% at Rekem 5 (Table 37). Because all types of refitting are compounded in this table, it should be interpreted with some caution. Detailed results of various refit types (debitage, tooling, breaks), are provided with the individual tool classes. Inter-locus variability is also discussed in chapter 6.

The observations made on all individual tools, as well as on Krukowski microburins and on burin spalls, are registered in annex 2 (Volume 2). They integrate the macroscopic features of blanks and tooling ends, dimensions, raw material types, results of refitting, and of the microwear analysis. Most of the tools are also illustrated. There is a reference to the Plates in the annexes allowing particular information on attribute descriptions to be gained for every single piece.

5.1.3 Glossary of terms relevant to tools

Although we have again attempted to adopt 'conventional' terminology, largely based on definitions proposed earlier in the literature[4], some terms might deserve more explicit clarification. They are defined below.

Bec: tool with two opposite retouched edges that meet in an acute angle; the 'drill bit' in this case has a rather heavy appearance (large and thick).

[3] Cf. Schiffer & Skibo 1997, 29: "... *design [of a tool] is driven by performance; that is, the artisan's behavior is influenced by an artifact's performances in activities throughout its life history.*"

[4] *e.g.* Inizan, Roche & Tixier 1992.

Table 37
Rekem habitation zone 1. Number of refitting tools and tool waste products by locus.
* only burin spalls and Krukowski microburins; other retouch flakes are not (yet) systematically inventoried.

Tool and tool waste product	Locus 1	4	5	6	7	8	10	11	12	13	15	16	Total N refitted	Total N pieces	% refitted
Lateral modified laminar piece - slender	4	1	14	2	3	-	-	2	2	-	-	-	28	282	10%
Lateral modified laminar piece - large	4	-	3	-	10	-	-	5	1	-	-	-	23	64	36%
Burin	9	-	53	11	2	-	14	5	8	-	2	3	107	261	41%
Scraper	1	-	20	2	-	-	1	-	3	-	-	4	31	162	19%
Truncated tool	5	-	4	1	1	-	1	-	-	-	-	-	12	73	16%
Borer/bec/reamer	-	-	3	-	-	-	2	-	-	-	-	1	6	40	15%
Composite tool	1	-	1	-	-	-	3	1	-	-	-	-	6	18	33%
Other retouched piece	1	-	3	2	1	-	2	-	-	-	-	1	10	31	32%
Total N tools refitted	25	1	101	18	17	0	23	13	14	0	2	9	223	931	24%
Total N tools	113	11	281	179	55	4	122	62	71	2	2	29	931		
% refitted	22%	9%	36%	10%	31%	0%	19%	21%	20%	0%	100%	31%	24%		
Krukowski microburins	1	-	1	-	2	-	-	-	-	-	-	-	4	42	10%
Burin spalls	8	0	61	14	1	-	15	13	10	1	0	6	129	356	36%
Retouch flakes	-	-	1	1	-	-	-	1	-	-	-	3	6	?*	?*
Total N tool waste refitted	9	0	63	15	3	0	15	14	10	1	0	9	139		
Total N tool waste*	35	1	145	65	18	0	45	45	32	1	1	10	398		
% refitted*	26%	0%	43%	22%	17%		33%	29%	31%	100%	0%	60%	33%		

Bending fracture (fig. 37): bending fractures are initiated from a large area and have a straight or convex profile along their whole area of initiation. They can run parallel with the opposite surface before meeting it in a feather (acute angle or curve less than or equal to 90°), a hinge (curve larger than 90°), or a step (a right angle with an abrupt change of direction) termination. Snap-terminating bending fractures meet the opposite surface of the artefact without having at any point run parallel to this[5].

Borer (piercer): cf. bec, but with a more intensely shaped, relatively narrow drill bit forming a sharp angle.

Burin (edge) angle: angle of intersection of the spall platform with the burin facet (fig. 38).

Burin bit or *cutting edge*: sharp, usually chisel-like edge formed by the intersection of a burin facet and the spall removal surface.

Burin edge / burin end / burin bevel: burinated part of the tool that includes the combination of spall platform and burin facet (multiple burins have more than one burin edge).

Burin facet: surface on burin consisting of one or several (parallel) scar(s) resulting from burin spall removal (fig. 39).

Burination: spin-off fracture resembling burin-spall scar[6].

Cone fracture: cone fractures begin from a point or a small, well-defined area, having a concave profile in the area of initiation.

Drill bit: retouched (pointed) extremity of borers, becs, and reamers.

Facet edge: steep edge formed by the intersection of a burin facet and the ventral or dorsal face of the original blank.

Feather (terminating) fracture: see bending fracture (fig. 37).

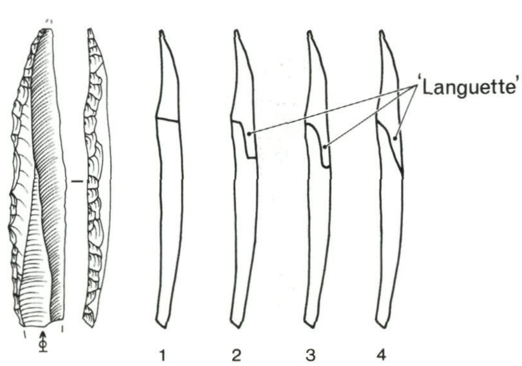
Hinge (terminating) fracture: see bending fracture (fig. 37).

Krukowski microburin: accidental waste product produced during backing of points and blade(let)s. They are generated when the retouching blow is delivered too far onto the blank that is being manufactured, removing a substantial part of it, and leaving a trihedral point on the tool.

Languette: in case of bending fractures: fracture zone running parallel with the flake surface (fig. 37).

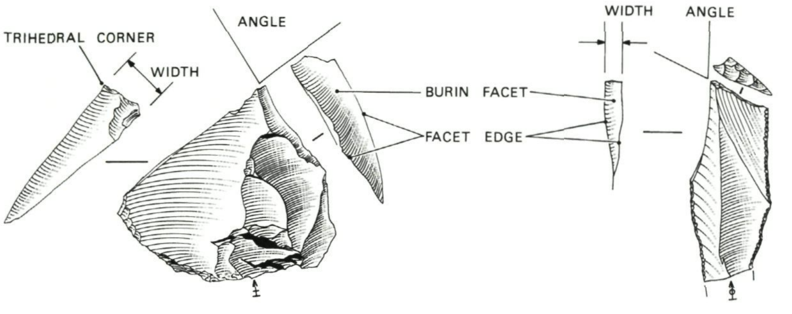
LMP: lateral modified laminar piece (*e.g.* backed point, blade with edge retouch).

[5] Fischer, Hansen & Rasmussen 1984.
[6] Odell & Cowan 1986, 204.



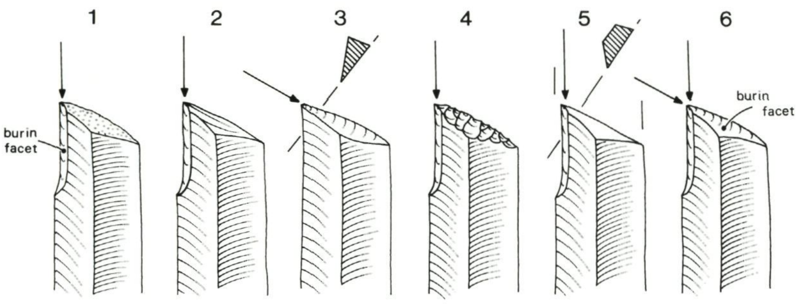
37 *Various types of termination on bending fractures:*
1. snap,
2. step,
3. hinge,
4. feather.

38 *Measurement of the burin edge angle and of the width of the burin facet.*



MLIT: microscopic linear impact traces (exactly parallel to the penetration axis of a projectile).
*Reamer (*Fr. *alésoir)*: bec or borer of which the drill is shaped by alternate retouch.
Scraper-head angle: angle between the ventral face of the blank and the retouched surface of the scraper-head, measured at the midpoint of the scraping edge.
Scraper-head: part of a scraper (at Rekem generally at the distal end of the blank) carrying the scraping edge.
Scraping edge (or scraper front): convex unifacially retouched edge at either one (or both) end(s) of a blank.
Scraping edge corner: meeting point of scraping edge and lateral edge of the blank.
Scraping edge cut: line of intersection between scraper front and ventral face of the blank (Fr. *arête tranchante* or *fil du front de grattoir*).
Scraping edge spurs: tiny spines (indentations) visible in plan on the scraping edge between two retouch scars (Fr. *épine*).
Snap (terminating) fracture: see bending fracture.
Spall (striking) platform or *spall removal surface*: surface that served as a platform for spall removal (fig. 39).
Spin-off (fracture): cone fracture which initiates from a bending fracture and which removes parts of the original surface of the specimen[7].
Step (terminating) fracture: see bending fracture (fig. 37).
Trihedral corner (bevel tip): meeting point of burin facet, spall platform and ventral (or dorsal) face of the original blank (fig. 38; at Rekem, this is generally the 'active' part of the burin).
Trihedral point: negative of Krukowski microburin scar.
Truncation angle: small angle of intersection of the truncation with the general axis of the blank.
Truncation: modification by continuous, generally abrupt retouch at the distal or proximal extremity of a blade or flake that does not represent a scraper-head.

39 *Various types of spall platforms : 1. a cortical surface, 2. an unmodified end, 3. an unmodified edge, 4. a truncation, 5. a transverse break, 6. a burin facet.*



5.2 Laterally Modified Laminar Pieces[8]

5.2.1 Description of abandoned tools

At Rekem, laterally modified laminar pieces (LMP) dominate the other "classic" *Federmesser*-industry type of tools of burins and scrapers, although the ratios differ considerably within the distinct concentrations (Table 34). The 363 LMP are either steeply backed or only minimally retouched (nibbled) on one or both edges. Seventeen pairs of fragments could be refitted, leaving 346 pieces to make up the general data-set used in the following analysis (Table 38). It includes twice as many unpointed as pointed pieces.

Flint types of LMP are presented in Table 39. Most elements were made out of coarse-grained grey flint (type 2; 56%) or fine-grained flint of the 'Hesbaye type' (type 1; 29%). The 13 specimens of flint types 3 and 4 were mainly located in the large domestic units Rekem 5 and Rekem 6. Thirty-seven pieces (11%) were too intensely burnt, and 1 too heavily patined, for their raw material types to be identified. Flint type specification by locus revealed a manifest predominance of elements in non-specified flint types, *i.e.* 222/281 (79%)[9]. Only 59 pieces could be tied to 15 specific flint types, *i.e.* 14 tools in 4 fine-grained types, and 45 LMP in 11 coarse-grained variants.

The three-dimensional histograms illustrate the maximum width and thickness of pointed and unpointed LMP (fig. 40). They reveal a clustered predominance of slender elements (5-12 mm wide and 1-6mm thick) as opposed to a diffuse scatter of some larger, heavier pieces over 12mm (to 29mm) wide and from 3 to 9mm thick. This observation justifies the division of the tools into two categories: one narrower (288 points and bladelets; 83%), the other wider (58 pointed blades and blades; 17%) than 12mm (Table 38). The functional and spatial analyses confirm that this distinction is indeed significant.

[7] Fischer, Hansen & Rasmussen 1984, 23.
[8] A condensed version of this analysis was published earlier (Caspar & De Bie 1996). The present text is an extended and more up to date account (especially with regard to the refitting work).
[9] If altered pieces, specimens of flint types 3 and 4, and elements of Rekem 2 and Rekem 14, both outside habitation zone 1 and not subjected to flint type specification, are not counted.

Table 38
Rekem 1984-86. Classification of laterally modified laminar pieces at the various loci, before and after refitting of fragments.

	Locus												Before refitting		After refitting	
Type	1	2	4	5	6	7	10	11	12	13	14	16	Total	%	Total	%
Slender LMP (W<=12 mm)																
Curved backed point	17	1	-	14	7	9	3	3	7	-	1	-	62	17%	60	17%
Straight backed point	4	1	-	12	6	1	3	2	-	-	-	-	29	8%	28	8%
Angled backed point	4	-	-	1	2	-	-	1	-	1	-	-	9	2%	9	3%
Obliquely backed point	-	-	-	-	-	1	1	-	-	-	-	-	2	1%	2	1%
Total backed points	25	2	0	27	15	11	7	6	7	1	1	0	102	28%	99	29%
Backed bladelet	12	2	2	46	17	7	24	9	17	-	9	2	147	40%	142	41%
Bladelet with marginal retouch	1	-	-	9	15	1	9	2	3	-	1	-	41	11%	41	12%
Bladelet with both edges retouched	-	-	-	3	2	-	-	-	2	-	-	-	7	2%	6	2%
Total lateral modified bladelets	13	2	2	58	34	8	33	11	22	0	10	2	195	54%	189	55%
Total slender LMP	38	4	2	85	49	19	40	17	29	1	11	2	297	82%	288	83%
Large LMP (W>12mm)																
Curved backed pointed blade	-	-	-	1	-	2	-	2	-	-	-	-	5	1%	3	1%
Straight backed pointed blade	-	-	-	1	-	3	-	-	-	-	-	-	4	1%	3	1%
Undulated backed pointed blade	6	-	-	1	1	1	1	-	-	-	-	-	10	3%	9	3%
Total pointed blades	6	0	0	3	1	6	1	2	0	0	0	0	19	5%	15	4%
Backed blade	4	-	-	7	1	11	-	10	2	-	2	-	37	10%	33	10%
Blade with marginal retouch	-	-	-	2	2	3	-	-	1	-	-	-	8	2%	8	2%
Blade with both edges retouched	-	-	-	-	1	-	-	-	1	-	-	-	2	1%	2	1%
Total lateral modified blades	4	0	0	9	4	14	0	10	4	0	2	0	47	13%	43	12%
Total large LMP	10	0	0	12	5	20	1	12	4	0	2	0	66	18%	58	17%
Total LMP before refitting	48	4	2	97	54	39	41	29	33	1	13	2	363	100%	346	100%
%	13%	1%	1%	27%	15%	11%	11%	8%	9%	0%	4%	1%	100%			
Total LMP after refitting	46	4	2	90	54	36	41	26	32	1	12	2	346			
%	13%	1%	1%	26%	16%	10%	12%	8%	9%	0%	3%	1%	100%			

5.2.1.1 Slender LMP: points and laterally modified bladelets

Two-thirds of the slender elements consist of laterally modified bladelets, and one-third of backed points (Table 38).

Points
Within the group of points, curved backed variants (N=60; Pl. 68: 1-9, Pl. 69: 5-15, Pl. 71: 1-4, Pl. 72: 1-2, 4-5, Pl. 73: 15-16, Pl. 74: 1-5,19), traditionally called Tjonger points[10] or *Federmesser*[11], clearly outnumber the other variants, although a slight overestimation may result from the integration of 4 small apical fragments in this category (*e.g.* Pl. 74: 9). In addition, rectilinear backed points (N=28; Pl. 68: 10-13, Pl. 69: 2,16-19, Pl. 71: 5-8, Pl. 72: 6, Pl. 73: 4-5), angled-backed points (N=9), and obliquely truncated points (N=2) are included. Of the angled-backed points, 6 pieces with a single angle on the back (Pl. 68: 14, Pl. 71: 9-10, Pl. 73: 17, Pl. 74: 16) can be labelled Creswell-points following the original description by Bohmers[12]. The three remaining pieces have a small portion of the back left unmodified, adjacent to the very oblique truncation that shapes the point tip (*e.g.* Pl. 68: 15). One of these (Pl. 69: 20) might alternatively be classified as a shouldered point. The two points with a very oblique truncation (Pl. 72: 7, Pl. 73: 6), correspond to Bohmers' type B points[13].

Many backed points are in a fragmentary condition. Lightly damaged and complete specimens (N=56, after refitting) range from 21 to 58mm in length, with a mean length of 38.7 ± 8.3mm. Their weight ranges from 0.4 to 3.3 g with a mean of 1.5 ± 0.7 g.

The point-tip on all the implements is predominantly situated at the distal end (three times out of four; Table 40), and is generally prepared with a normal steep semi-abrupt to abrupt retouch. The backed edges are mostly, but not always, completely retouched (N=85). No lateral preference can be observed for either left (N=47) or right (N=52) edge backing (Table 40).

10 Bohmers 1956, 9.
11 Schwabedissen 1954, 8.
12 Bohmers 1956, 11.
13 Bohmers 1956, 29.
14 Inizan, Roche & Tixier 1992.
15 Bohmers 1956, 9; Van Noten 1978, 45.

Table 39
Rekem 1984-86. Flint types of laterally modified laminar pieces at the various loci, after refitting of broken pieces.
0. Undetermined (patinated or heavily burnt) flint.
1. Fine-grained 'Hesbaye' flint.
2. Coarse-grained flint.
3. Mat fine grained grey flint with numerous light dots.
4. Translucent fine-grained brown flint.
See section 4.2.2.2 for description of specific flint types by locus.
* 1 of the 7 pieces in the cell of flint type 1/10 is actually of flint type 7/10 as it refits with set 07s32 of Rekem 7.

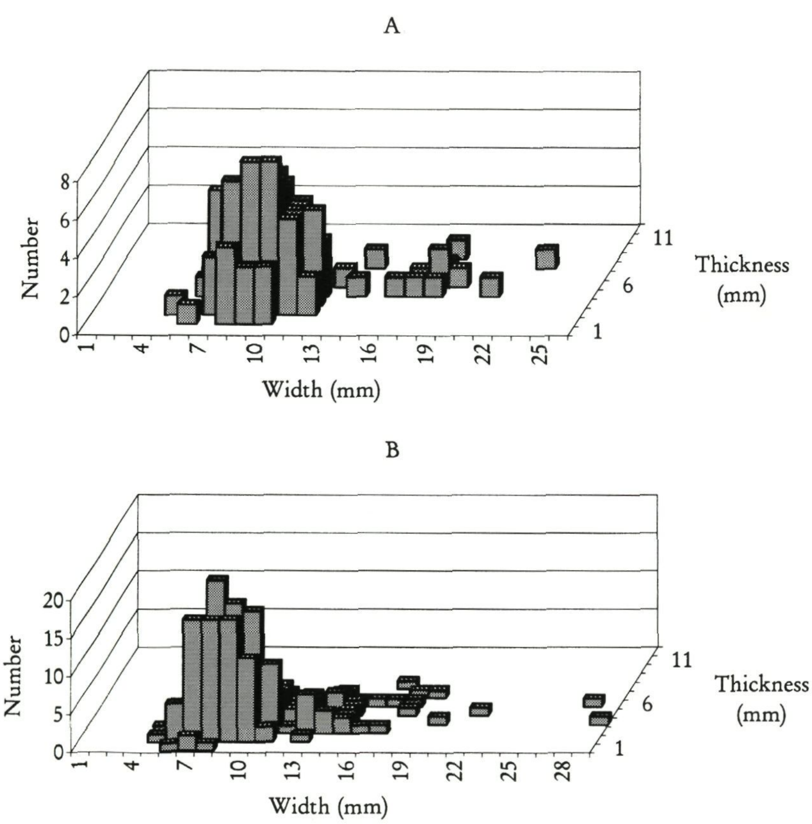
	Locus													
Flint type	1	2	4	5	6	7	10	11	12	13	14	16	Total	%
0	*7*	*1*	-	*6*	*5*	*6*	*3*	*6*	*3*	*1*	-	-	*38*	*11%*
10	7*	2	-	34	18	7	-	1	11	-	5	2		
11	-	-	-	4	1	-	3	-	-	-	-	-		
19	-	-	-	6	-	-	-	-	-	-	-	-		
Subtotal 1	*7*	*2*	*0*	*44*	*19*	*7*	*3*	*1*	*11*	*0*	*5*	*2*	*101*	*29%*
20	24	1	-	25	24	7	35	10	17	-	6	-		
21	-	-	-	-	-	13	-	2	1	-	-	-		
22	-	-	1	-	-	3	-	-	-	-	-	-		
23	-	-	-	-	-	-	-	7	-	-	-	-		
24	-	-	-	1	-	-	-	-	-	-	-	-		
25	7	-	-	2	-	-	-	-	-	-	-	-		
29	1	-	-	-	-	-	-	-	-	-	-	-		
212	-	-	-	7	-	-	-	-	-	-	-	-		
Subtotal 2	*32*	*1*	*1*	*35*	*24*	*23*	*35*	*19*	*18*	*0*	*6*	*0*	*194*	*56%*
3	-	-	*1*	*1*	*1*	-	-	-	-	-	*1*	-	*4*	*1%*
4	-	-	-	*4*	*5*	-	-	-	-	-	-	-	*9*	*3%*
Total	46	4	2	90	54	36	41	26	32	1	12	2	346	100%

One third of the points (N=35; Table 40) are partly backed with a crossed abrupt retouch, located mostly at a reduced part along the tip (N=25; Pl. 68: 3, 6, Pl. 69: 5,14,19, Pl. 71: 3,5,9, Pl. 72: 5,6, Pl. 74: 5,16) but sometimes also elsewhere along the edge (Pl. 68: 4,11, Pl. 69: 2, Pl. 71: 7, Pl. 72: 4, Pl. 74: 3,4). This retouch can be linked with a tooling technique executed on an anvil. Dorsal removals could be induced by the 'counter-blows' of that device[14]. Anvil retouch was only produced in those cases where the backing had removed a large part of the bladelet and thus crossed one of the major ridges on the dorsal surface (mostly upon angled and curved backed points). In fact, it generally originates exactly at this specific spot, where the section of the bladelet would allow the application of alternate retouch and where an anvil technique causes a similar result.

The slender backed points of Rekem are not truncated at the base. The basal part of the edge opposite the back presents direct retouch in five cases, 8 to 18mm long (Pl. 69: 1,9,13). This feature was observed several times at other sites, where it was construed as the removal of the bulb of percussion to improve hafting[15]. On the other hand, some pieces (N=15) show continuous series of small scars (Pl. 110: 4,5), limited to a short portion (between 4 and 12mm) of the edge, located at the base and/or central part (*e.g.* Pl. 69: 11,12; Table 40). These direct, inverse or alternating removals were obtained by pressure, probably to rectify and blunt this zone to prevent it from cutting the binding (see functional analysis below).

Bladelets
Except in a few cases, the bladelets have only single-edge modification, mainly with a steep/abrupt backing (N=142), generally along their entire edge (N=117). A smaller group possesses a minimally modified (nibbled) edge (N=41) which is either partial (N=16) or continuous (N=25). As with the points, absolutely no lateral preference could be observed (Table 40). Six elements bear a continuous steep backing or a minimal modification on both edges.

The edge modification is predominantly rectilinear (N=133; see examples on Pl. 68-74), although convex (N=30; Pl. 70: 10, 73: 12-13, 74: 6,10,20-21), some concave (N=6; Pl. 68: 23), angled (N=6; Pl. 68: 20, Pl. 69: 3,26, Pl. 71: 19, Pl. 72: 8), and a single sinuous outline also occur. In the case of two retouched edges, several combinations of shapes have been observed (Pl. 70: 14; Table 40). On 7 small fragments, the shape of the edge cannot be specified. In fact, about two-thirds of the pieces are fragments: in decreasing order, of central (N=72), proximal



40 *Rekem 1984-86. Tridimensional histogram of width versus thickness versus number of LMP. A) Pointed pieces; B) Unpointed pieces.*

Table 40
Rekem 1984-86. Various characteristics of laterally modified laminar pieces, after refitting of broken pieces.

	Points				Bladelets			Pointed Blades			Blades			Total
	Curved Back	Rectil. Back	Angled Back	Oblique Back	Backed	Marginal Retouch	Both Edges	Curved Back	Rectil. Back	Undul. Back	Backed	Marginal Retouch	Both Edges	
Total number	60	28	9	2	142	41	6	3	3	9	33	8	2	346
Position of point-tip														
Undetermined	-	2	-	-	-	-	-	-	-	-	-	-	-	2
Proximal	15	8	-	2	-	-	-	1	2	1	-	-	-	29
Distal	45	18	9	-	-	-	-	2	1	8	-	-	-	83
Edge shape														
Undetermined	4	-	-	-	4	3	-	-	-	-	2	1	-	14
Convex	56	-	-	-	26	4	-	3	-	-	3	4	-	96
Rectilinear	-	28	-	2	100	33	-	-	3	-	12	2	-	180
Angled	-	-	9	-	6	-	-	-	-	-	1	-	-	16
Concave	-	-	-	-	5	1	-	-	-	-	8	1	-	15
Sinuous	-	-	-	-	1	-	-	-	-	9	7	-	-	17
Two rectilinear edges	-	-	-	-	-	-	2	-	-	-	-	-	-	2
Rectilinear+convex	-	-	-	-	-	-	2	-	-	-	-	-	1	3
Two convex edges	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Convex+concave	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Two concave edges	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Position of retouched edge														
Left side	24	17	4	2	64	22		3	2	9	15	2	-	164
Right side	36	11	5	-	78	19			1		18	6	-	174
Both sides	-	-	-	-	-		6					-	2	8
Extent of retouch														
Continuous	51	28	6	-	117	25	-	1	-	4	19	3	-	254
Partial	9	-	3	2	25	16	-	2	3	5	14	5	-	84
Continuous+partial	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Both partial	-	-	-	-	-	-	5	-	-	-	-	-	2	7
Origin of retouch														
Direct	38	19	5	2	125	41	-	3	2	8	29	7	-	279
Inverse	-	-	-	-	1	-	-	-	-	-	-	1	-	2
Alternating	-	-	-	-	1	-	-	-	-	-	-	-	-	1
Both direct	-	-	-	-	-	-	4	-	-	-	-	-	1	5
Direct+inverse	-	-	-	-	-	-	2	-	-	-	-	-	1	3
Partially crossed	22	9	4	-	15	-	-	-	1	1	4	-	-	56
Position of crossed retouch														
At the tip	15	6	4	-	-	-	-	-	1	1	1	-	-	28
At the central part	1	2	-	-	13	-	-	-	-	-	2	-	-	18
At the basis	1	-	-	-	1	-	-	-	-	-	1	-	-	3
Tip+central	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Central+basis	-	1	-	-	1	-	-	-	-	-	-	-	-	2
Entire edge	4	-	-	-	-	-	-	-	-	-	-	-	-	4
Modification on opposed edge														
Small scars along basis	3	3	-	-	3	1	-	-	-	1	1	-	-	12
Retouch along the basis	4	-	-	-	-	-	-	-	-	-	-	-	-	4
Small scars at central part	5	1	-	-	9	7	-	-	-	-	-	-	-	22
Retouch at the central part	-	1	-	-	-	-	-	-	-	-	-	-	-	1
Small scars near the tip	-	1	-	-	3	-	-	-	-	-	-	-	-	4
Retouch near the tip	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Small scars basis+central	-	2	-	-	-	1	-	-	-	-	-	-	-	3
Retouch basis+central	-	1	-	-	-	-	-	-	-	-	-	-	-	1
Modification at basis+tip	-	1	-	-	-	-	-	-	-	1	-	-	-	2
Absent or blade(let) with two retouched edges	47	18	9	2	127	32	6	3	3	7	32	8	2	296

Table 41
Rekem 1984-86. Classification of Krukowski microburins of the various loci.

Type	Locus 1	5	7	10	11	12	Total	%
Distal Krukowski M. with finished point-tip	3	3	10	-	4	1	21	50%
Distal Krukowski M. with blunt end	3	1	4	1	2	2	13	31%
Distal Krukowski M. with broken end	-	-	2	-	2	-	4	10%
Proximal Krukowski M. with blunt end	1	-	1	-	1	1	4	10%
Total	7	4	17	1	9	4	42	100%

(N=34), and distal parts (N=17), which means that the determined edge shapes essentially describe only parts of the original outlines. Fifteen elements bear a crossed abrupt retouch (Pl. 70: 5, Pl. 74: 14,17,21), while again, 24 bladelets possess continuous series of either direct, inverse or alternating small scars along a length of 3 to 19mm on the unretouched opposed edge (Pl. 70: 7,11).

Of the (nearly) complete bladelets with lateral modification (N=66, after refitting), lengths range from 19 to 58mm, with a mean length of 33 ± 8mm. Weight varies from 0.2 to 3.4 g, with a mean of 0.9 ± 0.5 g.

5.2.1.2 *Large LMP: laterally modified blades and pointed blades*

Pointed blades
The larger elements have been subdivided into pointed and unpointed blades (Table 38). For (nearly) complete pointed blades (N=9), length ranges from 37 to 71mm (mean 56.9 ± 12.8mm), while weights of 3.4 to 9.7 g (mean 5.9 ± 2.5 g) were recorded. The back, mainly on the left (N=15), only once on the right edge, is mostly prepared with a direct steep, rarely a partly crossed, abrupt retouch (Table 40). The back can be curved (N=3; Pl. 70: 15, Pl. 72: 10-11, Pl. 73: 21-22), rectilinear (N=3; Pl. 70: 16, Pl. 72: 12-13), or sinuous/undulating (N=9; Pl. 68: 24-27, Pl. 70: 17, Pl. 72: 14, Pl. 73: 14) and can affect the edge partially or completely. The tip is mainly distal.

Unpointed blades
Within the group of unpointed blades, two pieces are shaped on both edges. The retouch is partly direct on one, low-angled on the other (Pl. 71: 25). 41 blades present a steep direct backing (N=33) or at times a minimal modification (N= 8) on a single edge. These modifications partially or entirely affect either the right or the left edge. Their outline is rectilinear (N=14; *e.g.* Pl. 74: 26-27), convex (N=7; *e.g.* Pl. 70: 22, Pl. 73: 18), concave (N=9; *e.g.* Pl. 74: 12), sinuous (N=7; *e.g.* Pl. 70: 20-21, Pl. 72: 15-16), angled (N=1; *e.g.* Pl. 70: 18), undetermined (N=3; *e.g.* Pl. 70: 19), or a combination of shapes on two edges (N=2; *e.g.* Pl. 71: 25; Table 40). The lengths of complete blades (N=7) range from 23 to 54mm (mean = 40.6 ± 10.0mm) and weights vary from 1.3 to 6.8 g (mean = 3.0 ± 1.9 g).

5.2.2 Description of tool waste: Krukowski microburins

Unlike true microburins, Krukowski microburins are believed to represent accidental waste, produced involuntarily during the backing of points and bladelets[16]. At Rekem, their waste rank is supported by the microwear analysis (see below). Within *Federmesser* assemblages, Krukowski microburins are very common in properly excavated sites[17]. However, these artefacts have seldom received the attention they deserve. They are most important for reconstructing the production technique of backed elements and for locating the spots where this production took place (section 6.3.4).

Krukowski microburins are generated mainly when the retouching blow is delivered too far onto the blade(let) being manufactured, thus removing a substantial part of it. This accident leaves a trihedral point (*piquant trièdre*) on the (backed) blade(let), and produces a fragment that presents retouch along one edge and a microburin-like facet along the surface which had served as the striking platform for the retouching blow.

The Rekem assemblage includes 42 Krukowski microburins (Pl. 74: 28-36; Table 41), dominated by coarse-grained flint types (Table 42). Most of these are distal end examples, mainly showing a finished point-tip, although blunt (Pl. 74: 32) or broken ends (Pl. 74: 36) also occur. Remnants of trihedral points on nearly half of them (Pl. 74: 33-34; Table 43) reveal that the removal of more than one Krukowski microburin during a single shaping process was not unusual.

As for the LMP, there is no lateral preference for the modified edge. The origin of the retouch is either direct (N=31) or crossed (N= 11; Pl. 68: 5, Pl. 74: 30,31,33,36). Direct retouch generally coincides with a ventral origin of the microburin blow (*i.e.* ventral 'butt'), whereas both ventral and dorsal 'butts' are observed when crossed retouch (presumably generated on an anvil) was applied (Table 43).

[16] Bordes 1957.
[17] Schild 1984, 203.

Table 42
Rekem 1984-86. Flint types of Krukowski microburins of the various loci.

Flint type	Locus 1	5	7	10	11	12	Total	%
Fine grained grey 'Hesbaye' flint	-	3	9	-	2	2	16	38%
Coarse grained grey flint	7	1	8	1	7	2	26	62%
Total	7	4	17	1	9	4	42	100%

Table 43
Rekem 1984-86. Various features of Krukowski microburins.

	Distal Krukowski M. with finished point-tip	Distal Krukowski M. with blunt end	Distal Krukowski M. with broken end	Proximal Krukowski M. with blunt end	Total
Total number	*21*	*13*	*4*	*4*	*42*
Trihedral point					
Present	11	6	1	1	19
Absent	10	7	3	3	23
Position of retouch					
Left side	9	7	3	3	22
Right side	12	6	1	1	20
Position of butt and retouch origin					
Direct retouch/ventral butt	15	9	3	3	30
Direct retouch/dorsal butt	-	-	-	1	1
Crossed retouch/ventral butt	3	4	1	-	8
Crossed retouch/dorsal butt	3	-	-	-	3
Position of spin-offs					
Ventral face	2	-	-	1	3
Dorsal face	11	8	4	1	24
'Frequency' and length of spin-offs					
N=1-3; L=0.2-1.0 mm	7	3	-	-	10
N=1-3; L=1.0-2.0 mm	1	-	-	-	1
N>3; L=0.2-1.0 mm	1	3	2	2	8
N>3; L=1.0-2.0 mm	4	2	2	-	8
Spin-offs total number	*13*	*8*	*4*	*2*	*27*

Finally, some technological observations on Krukowski microburins deserve attention in the light of the following functional analysis. Two-thirds of the specimens presented spin-offs along the edge opposed to the butt of the microburin-like facet (*e.g.* Pl. 68: 5, Pl. 72: 9, Pl. 74: 31-35; Table 43). When the Krukowski was struck from the ventral surface, these spin-offs were situated on the dorsal surface, while 'ventral spin-offs' are always found on Krukowski microburins with a 'dorsal butt'. This provides a firm indication that these spin-offs have a technological cause, and that they are the immediate result of the manufacturing process (cf. 'spontaneous retouch'). As they can be 'long' and/or 'frequent" (Table 43), it is important not to confuse these attributes with spin-offs adjacent to bending fractures that have a functional cause (section 5.2.3.2).

5.2.3 The use of LMP

Since microwear analysis of LMP showed slender pieces to be exclusively used as projectile components, an experimental shooting program was recommended.

5.2.3.1 Results of the archery experiments

In addition to the general experimental program (see chapter 1), an archery experiment (Pl. 108: 1-3) was conducted by firing missiles into complete carcasses with a walnut self-bow replica (draw weight 16.5 kg) of one of the oldest European bows, remnants of which were found at Holmegaard in Denmark[18]. The projectile heads were mounted on walnut arrows or reed stalks, while different means of attachment (pine resins and/or animal sinew) were successively applied. The results obtained are precisely comparable to those described by various other authors[19]. On a microscopic scale, the damage consists of narrow linear polishes, or of microscopic linear impact traces (MLIT), exactly parallel to the penetration axis. On a macroscopic scale, a variety of features like cone or bending initiating fractures with a feather-, hinge-, or step-termination occur. These may, moreover, be combined with lateral-edged or flat-faced "burinations"[20], or with "spin-off" fractures[21].

Aside from these general observations, the archery experiments were mainly designed to test specific hypotheses, which especially concerned the degree of fragmentation of projectile heads in relation to the hafting technique and the shaft material (section 5.2.3.2.1).

18 Becker 1945; Pirnay 1981.
19 Hayden 1979, 133-135; Odell 1978; Moss & Newcomer 1982; Moss 1983; Barton & Bergman 1982; Bergman & Newcomer 1983; Fischer, Hansen & Rasmussen 1984; Geneste & Plisson 1986, 1990; Caspar 1988; Dockall 1997.
20 Odell & Cowan 1986, 204.
21 Fischer, Hansen & Rasmussen 1984, 23.

Table 44

Rekem 1984-86. Microscopic condition of laterally modified laminar pieces at the various loci, numbers before refitting

* burnt and patined pieces not considered

	Locus													
Condition for micro-wear	1	2	4	5	6	7	10	11	12	13	14	16	Total	%
Not altered	27	3	2	61	31	28	15	20	19	-	12	-	218	60%
Weak mechanical alteration	1	-	-	11	5	-	4	2	5	-	1	1	30	8%
Medium mechanical alteration	3	-	-	9	2	1	11	-	3	-	-	-	29	8%
Strong mechanical alteration	-	-	-	4	6	1	5	-	2	-	-	1	19	5%
Patined	-	-	-	-	1	-	-	-	-	-	-	-	1	0%
Burnt	17	1	-	12	9	9	6	7	4	1	-	-	66	18%
Total	48	4	2	97	54	39	41	29	33	1	13	2	363	100%
% altered*	13%	0%	0%	28%	30%	7%	57%	9%	34%		8%	100%	26%	

5.2.3.2 Function of LMP

Except for most of the burnt pieces (55 of 66)[22] and one patinated fragment, all of the LMP have been analysed microscopically. A microscopic mechanical alteration affected 26% of the unburned and unpatined pieces, its degree varying at the various loci. This alteration is found mainly at the large "domestic" units (Rekem 5, 6, 12, and especially 10, where more than half of the pieces have been affected). At "limited use areas", such alteration is rarely present (Table 44).

5.2.3.2.1 Slender elements as missile components

Microscopic features

None[23] of the 243 analysed (complete or broken) slender pieces (Table 45) bear traces of use *en percussion posée*[24] for drilling or engraving[25] or for meat cutting[26]. On the contrary, 28% of the slender types (27 classified as point- and 42 as bladelet-fragments) bear marks characteristic of used projectile heads (MLIT; Pl. 68: 3,21, Pl. 69: 2-3,7-8,10,13,15,19,20, Pl. 70: 3-5,8-10,12,14, Pl. 71: 8,19,22-23, Pl. 72: 4-5, Pl. 73: 2,5,9,10,13, Pl. 74: 4,6,15,17-19,23-24, Pl. 110: 6, Pl. 111: 1-3).

In addition, 13 backed bladelets present traces of a linear meat polish on their unmodified edge (Pl. 68: 18, Pl. 69: 22, Pl. 70: 7, Pl. 73: 11). This is emphasised on 5 pieces by both polish spots created by length-wise contact with a solid substance (bone), and linear striations caused by the grinding of small detached chips (Pl. 69: 25, Pl. 71: 14, Pl. 74: 13). These traces accord well with those on blades experimentally used as barbs along the edges of piercing missiles[27]. On three such pieces, barb traces appear to be truncated by subsequent, diagnostic bending frac-

[22] Results with regard to the state of preservation were calculated before refitting, as refitted fragments may display different alterations.

[23] Except for aspects concerning the degree of fragmentation, the following results were calculated after refitting. As the functional analysis has shown that nearly all of the damaged lateral modified bladelets can be classified as functional projectile points, both points and bladelets are discussed together.

[24] Leroi-Gourhan 1971, 47-64.

[25] Van Noten 1968, 151.

[26] Keeley 1978, 83.

[27] Moss & Newcomer 1982.

Table 45

Rekem 1984-86. Synthesis of microscopic traces on laterally modified laminar pieces; numbers after refitting of fragments.

* calculation of use percentage is based on number suited for microwear analysis (MW).

LMP-type	Total number	N suited for MW	Butchering	Projectile head	Projectile barb	Barb reused as projectile head	Total	% used*
Point	99	79	-	27	-	-	27	34%
Bladelet	189	164	-	42	12	1	55	34%
Total slender LMP	*288*	*243*	*0*	*69*	*12*	*1*	*82*	34%
Pointed blade	15	14	3	-	-	-	3	21%
Blade	43	36	3	-	-	-	3	8%
Total large LMP	*58*	*50*	*6*	*0*	*0*	*0*	*6*	12%
Total	346	293	6	69	12	1	88	30%

Table 46
Rekem 1984-86. Observations of state of fragmentation and use diagnostics on slender LMP. Projectile heads: A = pieces with diagnostic macroscopic features: cone fractures; bending fractures with hinge, feather or step terminations; burinations; numerous spin-offs > 3 mm. With or without MLIT. B = Pieces without diagnostic macroscopic features with MLIT.

Type and state of fragmentation	*Before refitting* Projectile heads A	B	Barb	Barb reused as projectile head	No diagnostic features	Total	%	*After refitting* Total	%
Points									
Entire	-	-	-	-	16	16	16%	17	17%
With a tiny apical fracture	13	2	-	-	13	28	27%	28	28%
With a tiny fracture at the base	1	-	-	-	1	2	2%	2	2%
With tiny fractures at both extremities	6	1	-	-	-	7	7%	9	9%
Apical fragment	-	1	-	-	3	4	4%	4	4%
Pointed part	4	-	-	-	18	22	22%	21	21%
Pointed part with a tiny apical fracture	13	1	-	-	5	19	19%	17	17%
Basal part	-	1	-	-	1	2	2%	1	1%
Basal part with a tiny fracture at the base	2	-	-	-	-	2	2%	-	0%
Total points	*39*	*6*	*0*	*0*	*57*	*102*	*100%*	*99*	*100%*
Bladelets									
Entire	-	-	5	-	24	29	15%	32	17%
With a tiny fracture at the distal end	6	1	1	-	10	18	9%	19	10%
With a tiny fracture at the proximal end	4	-	-	-	4	8	4%	8	4%
With a tiny fracture at both extremities	4	-	1	-	-	5	3%	7	4%
Distal part	8	-	1	-	11	20	10%	17	9%
Medial part	46	2	2	1	26	77	39%	72	38%
Proximal part	12	3	-	2	21	38	19%	34	18%
Total bladelets	*80*	*6*	*10*	*3*	*96*	*195*	*100%*	*189*	*100%*
Total	119	12	10	3	153	297		288	

tures. The impact traces (MLIT) adjacent to one of these fractures (Pl. 70: 7) confirm the re-use of barbs as projectile heads.

Macroscopic features
Broken elements (from near-complete specimens to tiny fragments) represent the vast majority (N=252) of the slender LMP (Table 46). They comprise 84% of the points and 85% of the bladelets before refitting. Such a strong predominance of fragments is common to many Late Palaeolithic assemblages in NW Europe[28]. This is generally explained as evidence for their projectile function, although the presence of diagnostic impact damage has never been studied properly. At Rekem, apart from 8% of the pieces showing exclusively thermal fractures, 48% of the slender fragments display only non-diagnostic, snap-terminating bending fractures, which can be induced by diverse factors such as shaping mishaps, intentional breakage, trampling forces, or natural agents (post-depositional bioturbation, sediment pressure, etc.). Use should not be ruled out as a cause, however. The poor results of intra-locus refits of broken slender pieces (barely 7%) indicate that trampling or natural agents were certainly not the main cause. Both tool-production and use can be held responsible.

The remaining 44% of the damaged pieces, 38 points and 74 bladelets, show at least one initiating cone or bending fracture with, in decreasing number, a step, feather, or hinge termination. These features, clearly acquired after the shaping of the tool, are in every respect identical to those observed in the projectile experiments. More than one fracture in three shows mostly sparse and small spin-offs, > 0.2mm length, rarely > 2mm. Fourteen percent of the pieces display burinations, while lateral cone fractures affected one-fifth of them.

The length of the fracture zone running parallel with the flake surface exceeds 2mm in one-third of the cases. Although in the literature only fractures exceeding 2mm are considered diagnostic, both our experiments and our examination of archaeological pieces prove that fractures shorter than 2mm also may be caused by impact: 47% of the experimental, and 50% of the archaeological fragments with short fractures have MLIT. Moreover, some snap-terminating fractures are associated with micro- or macroscopic evidence for a projectile function. Macroscopically, 11% of the fragments with only one or two snap terminating fractures display burinations or lateral cone fractures clearly induced during impact (Pl. 69: 8, Pl. 71: 16). Microscopically, MLIT adjoining snap fractures, with or without secondary

[28] Van Noten 1978; Houtsma, Roodenberg & Schilstra 1981; Barton 1992; Bolus 1992; Fagnart 1997.
[29] Geneste & Plisson 1990, 314.

features, occur 17 times out of 99. Therefore, in contrast with former assumptions, more fragments with snap-terminating bending fractures should be regarded as used elements of arrow armatures. This was confirmed by our experiments, in which 15% of the fractures (19 of 125) are bending fractures with snap terminations. Interestingly, fragments with snap fracture facets associated with MLIT and/or diagnostic secondary features were chiefly found at retooling places of LMP, and are entirely absent from the manufacturing areas (see below).

The weakness of the macroscopic impact marks is also relevant for studying the missile propelling system. The extent of the trace marks on the points depends on two ballistic factors. Firstly the physical qualities of the projectile material and, secondly, the momentum, or the amount of energy, the projectile has at the moment of impact, dependent on speed and mass in terms of kinetic energy[29]. Hitherto, experiments have not accounted for all the differences caused by the first factor. As for the second factor, characteristics of the impact marks vary according to the mode of propulsion. Experimentally, the marks appear to be more predominant on javelin points launched with a javelin-thrower than on bow-fired arrowheads[30]. Despite their slightly lower velocity, javelin darts provide a greater momentum due to their substantially greater weight[31]. The ballistic characteristics of the curved, rectilinear, or angled backed points of Rekem – mean weight (1.5 ± 0.7 g), reduced width (mean = 9.8 ± 1.5mm), and shape – are all compatible with an armoury of slender missiles. The general weakness of the impact traces on the Rekem data-set argues in favour of low-weight bow propulsion. Even with limited momentum, these points easily penetrate animal tissues.

The high degree of breakage in the fired projectile points is linked with the way the elements are attached to their shaft. Experiments showed that points slotted into a lateral groove with resin often only remained intact (20 of 33) because they easily detached from their shaft at the moment of impact. Most fractures occurred at the apex (10 of 13), while only three projectiles broke at the shaft end. When they were bound very tightly, with or without resin added, the degree of fracture increased. Pieces then broke easily into at least three fragments (37 of 69 pieces) with a high fracture rate at the shaft end (71 of 112 fractures). The application of ligatures also caused an imbalance between the number of basal or medial fragments and the number of point fragments. The former remained attached to the shaft, while the point fragments were easily lost. With lashings wrapped past the end of the shaft onto the protruding point, point tip fragments still adhered to the shaft. These observations agree well with the archaeological record. Of the 131 missiles from Rekem, 28% are complete or almost complete points, 15% are point-tip parts, and 57% are medial and basal fragments. Also, some pieces displaying direct retouch, or a continuous series of small scars along the basal and/or central part of the edge opposite the back (see above), may reflect the use of lashings, as blunting this area probably served to prevent it from cutting the binding.

The nature of the shaft itself can be approached from the morphology of the basal fractures observed on 11% of the points which still retained the basal area. The presence of clear impact marks such as bending fractures with a step termination and a burination suggest these points were fixed into a shaft in which their base was forced against a hard obstacle (an inter-node segment of a reed stalk for instance). This was confirmed by our experiments, in which 8% of the points fixed into reed shafts show very similar fractures at their bases. When a wooden shaft was used, such basal fractures were absent since the arrow shaft itself split length-wise along the wood fibres, saving the missile base from a severe counter-shock.

5.2.3.2.2 Large elements: butchering devices and unfinished implements

Neither macro- nor microscopically larger pieces showed any diagnostic impact damage. A small number (N=6[32]) present clear traces of butchering (Pl. 70: 16, Pl. 73: 14,18,22, Pl. 111: 4; Table 45). The lack of hafting traces suggests that they were hand-held. The absence of use-wear traces on the majority of the large pieces may partly be explained by the presence of unfinished (discarded) LMP in this category. Certain fragments hardly deviate from the 12mm width and present a back that is often incomplete (Pl. 70: 17,18, Pl. 74: 12,26-27), while some refits join finished point tip fragments with barely shaped (and thus wide) basal fragments (Pl. 68: 26-27, Pl. 70: 20-21, Pl. 72: 12-13). Snap-fracture facets on some elements retain bulbar areas, which can result accidentally when the origin of the blow is located along the retouched edge (N=8). Blows originating from the dorsal surface (N= 3), on the contrary, are evidence of intentional fracturing, reducing the artefact's length.

5.2.3.2.3 Krukowski microburins: waste products of primary tooling

In contrast with evidence of barb recycling (section 5.2.3.2.1), no use-wear traces have been found on Krukowski microburins that might have suggested retooling or resharpening of used missile points. Rather, on most of these specimens, tooling on an anvil is evidenced by jumbled striations on the surface adjacent to the back, and to the edge opposed to the butt of the microburin-like facet. These randomly oriented features, with variable dimensions, are most likely due to crushing against an anvil.

30 Fischer, Hansen & Rasmussen 1984.
31 Bergman, McEwen & Miller 1988.
32 A critical revision has shown that 2 large LMP of Rekem 1, formerly published as butchering knives (Caspar & De Bie 1996) do not present obvious traces of use.

Table 47
Rekem habitation zone 1. Lateral modified laminar pieces. Refitting results by locus and by type.

Refitting type	Locus 1	4	5	6	7	10	11	12	13	16	Total	% refitted	Slender Point	Slender Bladelet	Large Pointed	Large Unpointed
Reduction sequence	3	1	3	2	5	-	1	1	-	-	16	5%	3	4	3	6
Tooling	1	-	-	-	2	-	-	-	-	-	3	1%	1	2	-	-
Fracture	2	-	13	-	4	-	4	2	-	-	25	7%	6	11	2	6
Reduction+fracture	2	-	-	-	2	-	2	-	-	-	6	2%	-	-	6	-
Tooling+fracture	-	-	1	-	-	-	-	-	-	-	1	0%	-	1	-	-
Total refitted pieces	8	1	17	2	13	0	7	3	0	0	51	15%	10	18	11	12
Not refitted	40	1	80	52	26	41	22	30	1	2	295	85%	89	165	8	33
Total	48	2	97	54	39	41	29	33	1	2	346	100%	99	183	19	45
% refitted	17%	50%	18%	4%	33%	0%	24%	9%	0%	0%	15%		10%	10%	58%	27%

5.2.4 Dynamic approach: use-lives of LMP

5.2.4.1 LMP blank production: results of dorsal-ventral refitting and flint type analysis

At the time of writing, 22 LMP were used in sequential refitting (debitage)[33]. Six of those are, moreover, combined in three break refits (Table 47), which in fact reduces their number to 19 tools (after refitting of fragments; Table 48: pieces of codes 1, 24, 54, and 74 in 'origin of blank').

Refitting in production sequences has been definitely more successful for large LMP (12/57 or 21%) than for slender elements (7/273 or 3% only; Table 48). The former are either shaping mishaps discarded at their spot of manufacture, or devices that served for butchering and are thus associated with "domestic" tool categories (burins, scrapers, etc.), which, at Rekem, are frequently made, used, and discarded on the same spot (see below). It is not altogether impossible that some LMP-forms were sporadically produced when in fact other type of tools were intended.

Slender elements, on the other hand, as projectiles, were essentially intended for use away from the site, and were thus by definition more mobile. There is, in fact, one LMP from the 'dump spot' of Rekem 1 (Pl. 75: 2) that refits with a randomly retouched tool and with another LMP (Pl. 75: 3) at the 'production area' of Rekem 7 (Table 48: code 74). The other slender LMP joined in ventral-dorsal refits are mainly 2 pairs of unused, backed pieces, located at Rekem 5 (Pl. 69: 23-24) and at Rekem 6 (Pl. 71: 26; Table 48: code 54). They do not refit with any other artefact of those concentrations, and might be viewed as small "reserves" of LMP, which were probably imported from their production area, and abandoned (lost?) at the retooling loci before insertion into a shaft[34]. In any case, they provide sparse but clear indications of the serial production of slender LMP. Other series of unused slender LMP, which are not

Table 48
Rekem habitation zone 1. Origin of blanks of laterally modified laminar pieces as evidenced by dorsal-ventral refitting and by flint type analysis (counts after refitting of fragments of broken pieces).
Legend for origin of blank:
1. Refitted in a local reduction sequence including debitage waste material.
2. Unrefitted, but debitage waste material of this specific flint type is refitting at the locus.
24. Refitted with other tool only, but debitage waste material of this specific flint type is refitting at the locus.
3. Unrefitted, but member of a specific flint type including non-refitting debitage waste material at the locus.
5. Unrefitted and member of an unspecified flint type.
54. Member of an unspecified flint type refitted in a dorsal-ventral refit lacking debitage (i.e. only with other tools).
6. Unrefitted member of a flint type lacking debitage waste material.
74. Refitted with tools of other locus.

Class	Origin of blank	Locus 1	4	5	6	7	10	11	12	13	16	Total	%
Large LMP	1	2	-	1	-	3	-	2	1	-	-	9	16%
	2	1	-	2	-	5	-	4	-	-	-	12	21%
	24	1	-	-	-	1	-	-	-	-	-	2	4%
	3	-	-	-	1	-	-	-	-	-	-	1	2%
	5	5	-	8	4	7	1	4	3	-	-	32	56%
	54	-	-	-	-	1	-	-	-	-	-	1	2%
Total large LMP		9	0	11	5	17	1	10	4	0	0	57	100%
Slender LMP	1	-	1	-	-	1	-	-	-	-	-	2	1%
	2	4	-	11	6	7	3	5	-	-	-	36	13%
	3	-	-	10	-	-	-	-	-	-	-	10	4%
	5	32	-	55	41	11	37	11	28	1	2	218	80%
	54	-	-	2	2	-	-	-	-	-	-	4	1%
	6	-	1	1	-	-	-	-	-	-	-	2	1%
	74	1	-	-	-	-	-	-	-	-	-	1	0%
Total slender LMP		37	2	79	49	19	40	16	28	1	2	273	100%
Total		46	2	90	54	36	41	26	32	1	2	330	

Table 49
Rekem habitation zone 1. Compilation of refit-sets in which several tools are conjoined, including at least one LMP.

	Tool type					
	LMP		Burin	Truncation	Other	Tool
Refit-set	Slender	Large			tool	total
01c05	-	3	-	-	-	3
05s109	2	-	-	-	-	2
06s68	2	-	-	-	-	2
07s32	1	1	-	-	1	3
01s50	-	1	-	2	-	3
07c06	-	2	1	-	-	3
07c08	-	1	2	-	-	3
05c03	-	1	13	1	1	16
07s36	-	1	-	1	1	3
Total	5	10	16	4	3	38

refitted, but manufactured in a single, peculiar flint type at Rekem 5, sustain this observation (*e.g.* Pl. 69: 5, 18 are manufactured in a very specific orange-yellow flint type with a specific orange cortex, codified type 5/19). Finally, the refit of 1 small partly retouched bladelet in a production sequence at Rekem 4 (Table 48: code 1) completely deviates from the general patterning. In fact, it can be questioned whether retouch was truly intended in this case. On the other hand, at most of the loci, a local production of LMP blanks can certainly not be excluded, given the numerous unrefitted pieces with flint types identical to flint types of other artefacts at the locus (Table 48: codes 2 and 3).

In all, 3 loci especially (Rekem 1, 7, and 11), supply clear evidence of a serial production of LMP. In those cases, however, the 'finished elements' obviously left the area[35], and what remained are rejected pieces. Together, though, they provide at least an impression of the variability of type of tools generated during the LMP production process. At Rekem 7, for instance, a very specific flint nodule (type 7/21), apparently served for the production of a range of LMP-types, broken or not, and all discarded on a very limited surface: 2 curved backed points (Pl. 75: 10,12), 1 rectilinear backed point (Pl. 72: 6), 1 obliquely truncated point (Pl. 72: 7), 2 backed bladelets (Pl. 72: 9, Pl. 75: 13), 2 fragments of a curved backed pointed blade (Pl. 72: 10-11), 1 rectilinear backed pointed blade (Pl. 72: 3), 1 undulated backed pointed blade (Pl. 72: 14), and 4 backed blades or blades with marginal retouch (Pl. 75: 4,11,14). The fragments of these tools are all broken in snap terminating bending fractures, with or without a bulb of percussion, as a result of accidental breakage during retouching. Notwithstanding this 'heterogeneity', however, the reduction refits show that the production of blanks for LMP manufacture required a degree of standardisation, higher than for any other type of tool at Rekem (cf. chapter 4).

Combinations of LMP with other type of tools in a single reduction refit are rare, never include used projectiles, and are essentially restricted to the production areas of Rekem 7 and Rekem 1 (Table 49). The truncated tools (Pl. 75: 9) and 'randomly' retouched pieces are very 'atypical' and might alternatively also be regarded as unfinished, quickly discarded LMP. Conversely, the occasional combination of burins with LMP (Pl. 75: 8) at Rekem 7 is more enigmatic, given the functional dichotomy between both these type of tools. At Rekem 5, on the other hand, it is not inconceivable that the unused basal fragment of a LMP (Pl. 75: 6) that refits in co-set 05c03 at Rekem 5, represents the proximal fragment of a broken burin. Both the deviating reconstructed outline of the original blank and the fact that this piece carries cortex on its 'cutting edge' are inconvenient features for a projectile function. Moreover, the numerous burins refitting in co-set 05c03 also frequently display laterally modified edges (section 5.3.1.3).

The 'domestic' loci of Rekem 5, 6, 10, and 12, served as LMP retooling areas. Here, the local production of LMP could not be demonstrated by refitting. Still, several LMP at these loci present lithological characteristics associating them with other artefacts as well as with refitted reduction sequences including other type of tools (scrapers, burins, cf. chapter 6). In case these LMP would truly belong with those sequences, two interpretations can be forwarded: either they were indeed produced locally, or else they were manufactured on 'recycled blanks' already available on the soil of these loci. In any case, the occasional presence of Krukowski microburins does not exclude this hypothesis.

5.2.4.2 *Tooling refits*

Four Krukowski microburins (10%) could be refitted onto their points (Pl. 68: 5, Pl. 70: 1, Pl. 72: 8-9). In three cases, backing of the point continued after the Krukowski microburin had been removed. This implies that pieces suffering from shaping mishaps could still be resharpened. The fact that shaping accidents did not necessarily lead to the immediate abandonment of fragments explains why only a few fragments could be refitted. Additionally,

33 Since the publication of Caspar & De Bie (1996), several new reduction refits could be added to the refitting results at Rekem.

34 The phenomenon of transported 'reserves', *i.e.* a spatial disconnection between tools of a single refit set and their debitage waste, could not unequivocally be documented for 'domestic tools' (burins, scrapers,...). It seems that the spatial distinction between production areas and spots of use, were far less important in those cases (see chapter 6).

35 In general, extreme mobility of the LMP seriously impedes demonstration by refitting of serial production of these implements. To our knowledge, there is also very few evidence in this respect in the literature. One example, *i.e.* a combination of a large LMP with a curved backed point, has recently been reported from the *Federmesser* site of Ambenay (Eure, France; Valentin 1995, Pl.66).

10 fragments of (large) LMP could be conjoined at fractures that emerged during retouching (Pl. 70: 20-21, Pl. 72: 10-11,12-13,15-16, Pl. 73: 21-22).

5.2.4.3 *Refitting of broken LMP*

Considering the elevated fragmentary state of LMP, and despite systematic attempts, the achievements of break refitting have remained meagre: 18 slender LMP (7% of the fragments), and 14 larger pieces (24% of the 59 broken elements) could be conjoined on their fractures (Table 47). Refitting the latter has obviously been more successful because of the numerous breaks in this category that occurred during backing and with broken pieces being discarded on the spot. Essentially, these conjoinments should be regarded as 'tooling refits' (see above).

The poor results of the intra-locus refits of broken slender pieces indicate that the fragments which broke off during the hunt (generally point-tips) rarely arrived back in the camp area. Two fragments which refitted in a diagnostic projectile fracture, probably still adhered to the shaft (Pl. 69: 14-15, Pl. 70: 8-9). Several other fragments – especially at Rekem 5 – join at an undiagnostic snap fracture (Pl. 68: 8-9, Pl. 73: 19-20) and were found next to each other. Their breakage may be ascribed to trampling or to a post-depositional process.

5.2.4.4 *LMP fabrication and 'evolution': the limited 'dynamics' of arrow armatures*

Despite the moderate refitting results, some technical aspects of the LMP production process could be nicely documented.

Firstly, the unmodified blades selected for LMP manufacture can be reconstructed and measured for 7 slender and 2 large backed pieces that were refitted into reduction sequences (Pl. 75). Their original length and width were respectively (in mm): 41 x 13, 44 x 14, 50 x 13, 51 x 13, 60 x 13, 47 x 12, 58 x 13, 51 x 18 and >65 x 17 (cf. fig. 33). These measurements reveal that the blanks selected for the fabrication of slender backed pieces were fairly standardised, and are narrow blades rather than bladelets[36]. It is only after modification of the entire (!) edge that they become less than 12mm wide, and thus fall into the category of *slender* LMP, suited for a projectile function. On average, backing reduced the width of the original blades by about 3-4mm.

Secondly, we have already suggested that the presence of a (partially) crossed backing on one third of the points might be linked with an anvil technique. Dorsal removals would have been induced by the 'counter-blows' of the anvil, when the backing crossed one of the major ridges on the dorsal surface (mostly upon angled and curved backed points). Anvil tooling was also suggested on the Krukowski microburins, by the presence of microscopic jumbled striations on the surface adjacent to the back and to the edge opposed to the butt of the microburin-like facet (section 5.2.3.2.3).

Thirdly, the numerous point fragments and Krukowski microburins as well as the apical position of most trihedral points show how manufacturing the point-tip was a most delicate task and a frequent cause of fracture. A refitted piece with a well-formed point-tip (rectilinear, bi-directional), and an incompletely backed lateral edge (Pl. 72: 12), suggests that creating the tip was also the first task. The special attention the point-tip received relates both to its fragility and its function as the missile's head. Conversely, the general lack of basal modifications for ligatures on the non-retouched edges of LMP at Rekem 7 and Rekem 11 suggests that these were applied in a further stage of the production process, and confirms the unfinished state of pieces discarded at the production areas.

As opposed to most other tool types (see below), LMP were in general not subjected to "use-resharpening-reuse" cycles. They were designed to arm arrow shafts and then were normally abandoned when damaged as a result of their use. No use-wear traces have been found on Krukowski microburins that might have suggested the retooling or resharpening of used missile points. There may, however, have been occasional exceptions. On three backed bladelets, barb traces appear to be truncated by subsequent, diagnostic bending fractures (Pl. 70: 7). In these cases, the impact traces (MLIT) adjacent to one of these fractures confirm the re-use of the barbs as projectile heads. Moreover, some very long, used projectile heads at Rekem 7, might possibly be interpreted as pieces meant to be resharpened (Pl. 72: 4,5, Pl. 75: 15; section 6.3.4.1.) but this cannot, of course, be proven. On the whole, LMP can be regarded as implements that were generally only used once (or at most until they were damaged).

5.2.4.5 *Discard of LMP*

As arrow armatures, LMP are in the first place lost during the hunt. In the case of base frag-ments, they may also be abandoned at the retooling areas in the camp. On the other hand, at the production places, LMP were either discarded as unfinished implements (when the 'appropriate design' could not be achieved any more, *e.g.* when the remnant part became too short or possibly too thick; Pl. 72: 3,9),

[36] The size required for the LMP *supports* might also explain the fact that cores at the production place of Rekem 7 are generally abandoned once the core table has attained a length of about 5 cm. The table lengths of cores appropriate for blade production at this locus are, in dimensional order, 40, 42, 49, 50, 51, 51, 54, and 55mm. Even if in some cases appropriate small blades could have been produced after platform renewal, they would have become too short to serve as blanks for LMP. A similar observation was noted at the *Federmesser* site of Ambenay (Eure, France), where the length of laminar blanks selected for LMP production "*ne doit pas être beaucoup inférieur à 50mm.*" (Valentin 1995, 516).

or because of tooling accidents. In fact, at these loci, hardly any piece was abandoned in a 'finished' state.

In conclusion, as opposed to most other tool types (see below), LMP do generally not participate in "manufacture-use-rejuvenation-reuse" cycles. Throughout their entire use-life, these tools have to conform to more or less rigid schemes during the production and selection of blanks, as well as to particular design requirements during the shaping process. Whenever the artisan failed to provide the future arrow armature with the necessary qualities, the project was given up. Flexibility in those cases is far more limited than in the production processes of other type of tools.

5.2.5 Discussion

5.2.5.1 'Federmesser': *points or knives?*

At Rekem, the old debate about the function of 'Tjonger points' or '*Federmesser*' can in some way be settled. In fact, with regard to the type-function dichotomy, a distinction based on the tool width was found to correlate with a functional division. A first group of slender elements (width ≤ 12mm), was exclusively used as the components of light projectiles. A few elements of the second group, consisting of large LMP (mean width 17.4 mm) show use-wear from butchering. Most, however, could be defined as discarded tooling accidents.

The characteristics and position of the observed macro- and microscopic wear or damage traces on the slender elements, the high degree of fragmentation, and the small scars along the basal zones, all provided data which allowed the reconstruction of the material of the shafts (reed). They also allowed the identification of the fastening devices (firmly bound ligatures) used to secure the projectile head onto the shaft. Functional analysis has also attested the (limited) use of complete bladelets as barbs on the arrow flanks. The large majority of backed and laterally retouched broken bladelets were clearly fragments of projectile heads, however.

Absence of butchering traces on the slender, backed bladelets from Rekem distinguishes this *Federmesser* assemblage from, for example, the Late Magdalenian assemblages of Pincevent, where some backed bladelets were clearly used as meat knives[37]. Conversely, although most backed bladelets at Pincevent were broken, impact fractures were rare[38]. The opposite situation at Rekem, may reveal a change in subsistence procurement modes. The use of the bow and arrow is suggested by the size of the projectiles and by the degree of damage noted on the used points. It is likely that this weapon was already known in the Gravettian[39], the Solutrean[40] and maybe in the Hamburgian[41]. However the Magdalenian people who locally precede the *Federmesser* occupation mainly employed the javelin-thrower to hunt large herds of reindeer or horses[42]. This large scale introduction of archery coincided with a time of climatic change and its practice may therefore reflect the population's adaptation to a reforested Alleröd environment. In such a landscape the hunting of solitary animals, or those living in small groups (elk, red deer, wild pig, ibex, red fox, beaver, etc.[43]) would have necessitated the use of a more accurate weapon[44]. This weapon would remain the most essential one for the acquisition of food during the following millennia[45].

5.2.5.2 LMP as cultural markers?

Apart from the dimensional differentiation between slender and large LMP, other morphological variables could not be linked with functional aspects. The question therefore rises whether or not the shapes of the backs, retouch varieties, etc. on LMP, can be seen as mere stylistic attributes. Traditionally, point type varieties have always played a major role in determinations of 'cultural' groupings in NW European Late Palaeolithic industries.

As arrow armatures hafted in a preconceived shaft, these tools must carefully respect criteria of efficacy regarding the penetrating potential of the point tip, the shape of the base, general outline, volume, and weight. One would logically expect these implements to be designed after a well-defined prefiguration in the artisans' mind (an 'ideal concept'), and therefore to be valuable idiosyncratic manifestations of the material culture at issue. From this point of view, projectile points could provide more significant 'stylistic' potential than other typological categories of 'more flexible', domestic tools[46]. However, the reconstitution of this 'preconceived formal project' is heavily obliterated by the very incomplete state of the archaeological record.

At the production areas (section 6.3.4.1), the LMP assemblage consists primarily of three types of artefact. Firstly, there are the fragments generated during tooling accidents. Secondly there are abandoned unfinished implements of which the diverse types (*e.g.* partly backed edges, angled backs, etc.) obviously do not (or only partly) reflect the original intentions of the artisan. Thirdly there are the rare finished items that were nevertheless rejected by the artisan. Clearly, such amalgam can hardly be considered a 'typical' assemblage of Rekem LMP types. For example, in a traditional typo-morphological approach, the variability observed in a series of LMP produced in a single reduction sequence[47], could have been easily explained as a mixture of various 'cultural traditions'.

Around the large hearths, on the other hand, pieces that were actually selected by the hunter and used outside the camp area are generally present in a fragmentary state, and the original layout of the tools can mostly no longer be recognised. Possible haft-related attributes (modified opposed edges, retouched bases, shoulders, etc.) equally contribute to a decay of the original 'model type' in those cases. In fact, at Rekem, even the set of slender LMP that were seemingly approved of by the hunter and were

[37] Moss & Newcomer 1982, 293.
[38] Moss & Newcomer 1982, 296; Plisson 1985, 208.
[39] Nuzhnyi 1990, 123.
[40] Geneste & Plisson 1990, 314.
[41] Rust 1943; Sturdy 1975; Bokelmann 1991.
[42] Bosinski 1990, 251; Stodiek 1993.
[43] Bolus 1992, 19-20
[44] Stodiek 1993.
[45] Rozoy 1989.
[46] De Bie & Caspar 1997, and see below.
[47] *e.g.* the series at Rekem 7, which even includes a Mesolithic Zonhoven-point type (section 5.2.4.1).

still more or less complete, present poorly standardised layouts.

In all, we are not convinced that LMP as a tool class can be instantly employed as 'fossil directors' or 'cultural markers' to differentiate regional (or chronological) facies within the *Federmesser* groups. While we begin to control certain aspects (*e.g.* tooling accidents versus utilised pieces), it is clear that they cannot account for the total variability within the group of LMP. In fact, we still largely ignore the potential impact of factors like the nature of the shaft, the species of the hunted animal (small or large mammals, birds, fish,...), the status of the hunter, etc. On the other hand, it is not inconceivable that during this incipient tradition of bow and arrow hunting, the technical skills, in their experimental phase, have not yet acquired the rigid conventions that will develop with the appearance of the standardised microliths in the Mesolithic societies of NW Europe. The weapons of this new technology show a very dynamic evolution that, from a functional point of view, seemingly attempts to combine three demands in an optimal way. The first is the penetrating potential of the weapon. The second is its capacity to produce a large wound and the third is the optimal symmetry of the armatures to assure the stability and the equilibrium of the arrow[48]. The poor 'standardisation' of point types in the *Federmesser* groups, where a 'continuum' exists between the various 'types' established in the traditional classifications (*i.e.* mainly based on the outline of the retouched edges: rectilinear, curved, angled, etc.), possibly reflects a hunting technique that is still dawning at that time. Moreover, indications of lateralisation seem to be completely lacking for the armatures of the *Federmesser* assemblages. While left or right lateralisation provides major arguments in 'stylistic' studies of certain final Mesolithic microlithic industries[49], for the *Federmesser* groups, regional distinctions on this basis have as yet not been demonstrated.

48 Fischer 1989.
49 Gendel 1987.
50 Not counting the heavily burnt specimen, species in flint types 3 and 4, and the burins of Rekem 2 and Rekem 14, of which the specific flint types have not been defined yet.

5.3 Burins

Because of their large number and the great potential for a dynamic approach, burins are discussed at considerable length.

5.3.1 Description of 'abandoned tools'

If lateral modified pieces, both points and blade(let)s, are considered as a single tool class (N=363), burins represent numerically the second largest tool category (N=274) at Rekem. They outnumber the scrapers at most of the concentrations (Table 34).

Three quarters of these tools are made out of coarse-grained grey flint (code 2), most of the others of the fine-grained variant (code 1). Other flint types are very rare in this tool category (Table 50). Only one specimen was too intensively burnt for its flint type to be recognised. Almost half of the burins (111/254[50]; 44%) could be ascribed to a specific flint type, *i.e.* 24 in fine-grained types, 87 in various coarse-grained variants. The elements in unspecified flint types (N=143) include 32 burins in fine-grained, and 111 in coarse-grained flint.

The blanks selected for burin manufacture are marked by their great formal diversity. On a very general level, however, there seems to be a preference for elongated elements (cf. chapter 4). A majority of the burin blanks (60%) have more or less regular, parallel edges and ridges, and triangular (38%), trape-5zoidal (52%), or multi-facetted (9%) cross-sections. Another 20% have cortex on more than one third of the dorsal face; 8% of the burins are made on trimming flakes or blades, and 11%, finally, on 'irregular' blanks (Table 51).

In our description of the burins, we will try to reconstruct the complete '*chaîne operatoire*', that is, we will try to clarify how burins were made at Rekem

Table 50
Rekem 1984-86. Flint types of burins at the various loci.
0. Undetermined (patinated or heavily burnt) flint.
1. Fine-grained 'Hesbaye' flint.
2. Coarse-grained flint.
3. Mat fine grained grey flint with numerous light dots.
4. Translucent fine-grained brown flint.
See section 4.2.2.2 for description of specific flint types by locus.
* 2 of the 5 pieces in the cell of flint type 1/21 are actually of flint type 7/21 as they refit with co-sets 07c06 and 07c08 of Rekem 7; 1 burin in flint type 5/11 refits with a scraper at Rekem 6; the single specimen in the cell of flint type 10/22, situated in the 'intermediate burin area' between locus 10 and locus 11 (map 142), is actually of flint type 11/22.

	Locus													
Flint type	1	2	4	5	6	7	10	11	12	14	15	16	Total	%
0	-	-	-	-	*1*	-	-	-	-	-	-	-	*1*	*0%*
10	3	1	-	4	11	-	5	7	1	-	-	1		
11	-	-	-	11*	1	-	5	2	3	-	-	-		
12	-	-	-	-	-	-	-	-	1	-	-	-		
19	-	-	-	-	-	-	1	-	-	-	-	-		
Subtotal 1	*3*	*1*	*0*	*15*	*12*	*0*	*11*	*9*	*5*	*0*	*0*	*1*	*57*	*21%*
20	14	5	6	20	33	-	32	2	4	7	-	-		
21	5*	-	-	6	2	2	3	2	4	-	1	5		
22	1	-	-	-	2	-	1*	2	-	-	1	-		
23	1	-	-	8	-	-	-	2	-	-	-	-		
24	2	-	-	17	-	-	-	1	-	-	-	-		
25	-	-	-	12	-	-	-	2	-	-	-	-		
26	-	-	-	3	-	-	-	-	-	-	-	-		
29	-	-	-	2	-	-	-	-	-	-	-	-		
Subtotal 2	*23*	*5*	*6*	*68*	*37*	*2*	*36*	*11*	*8*	*7*	*2*	*5*	*210*	*77%*
3	*1*	-	-	-	*1*	-	-	-	-	-	-	-	*2*	*1%*
4	-	-	-	*2*	*2*	-	-	-	-	-	-	-	*4*	*1%*
Total	27	6	6	85	53	2	47	20	13	7	2	6	274	100%

Table 51
Rekem 1984-86. Blank types selected for burin manufacture.

Cross-section	Blank type Unknown	Cortical piece	Trimming piece	Parallel edges/ridges	Irregular blank	Total	%
Not observed	1	-	-	1	-	2	1%
Triangular	-	24	14	62	4	104	38%
Trapezoidal	-	9	2	86	6	103	38%
Multi-facetted	-	3	-	14	3	20	7%
Irregular	-	19	5	1	20	45	16%
Total	1	55	21	164	33	274	100%
%	0%	20%	8%	60%	12%	100%	

(largely based on refits), how they were used (functional analysis), and how (and why) they were finally abandoned. In traditional approaches, only the final stage – a description of what is left archaeologically – is generally provided in a form of typological analysis. We will also start with this.

5.3.1.1 Typology

What follows is thus initially a description of the archaeological data-set of the burins before refitting. Clearly, this portrait only reflects the final stage of the modification procedures. Refits and remnants of former situations prove that in the course of manufacturing, use, and retooling processes, burins could traverse many different formal types. At Rekem, they probably represent the most dynamic and flexible tool category. Much of the subsequent discussion will precisely touch upon this 'flexibility'.

In the typological classification used here, distinctions were made at several levels. Firstly between simple or multiple burins. Secondly, according to the type of spall platform – unprepared, fracture facet (break), dihedral, and truncation before or after ('atypical Lacan burin') delivery of the burin blow. Thirdly according to the orientation of the spall platform and the burin facet on the burin end (oblique, transverse or lateral; Table 52). Other characteristics (*e.g.* shape of the spall platform, dimensions, etc.) are included in a list of attributes (annex 2) and will be discussed further below.

Table 52
Rekem 1984-86. Classification of burin types inventoried at the various loci.

Type	Locus 1	2	4	5	6	7	10	11	12	14	15	16	Total	%
Lateral burin on oblique unmodified end	-	-	-	1	1	-	-	-	-	-	-	-	2	1%
Lateral burin on transverse unmodified end	2	-	-	1	1	-	1	-	-	-	-	-	5	2%
Medial burin on oblique unmodified end	1	1	-	1	1	-	-	-	1	-	-	-	5	2%
Transverse burin on unmodified edge	-	-	1	1	-	-	1	-	-	1	-	-	4	1%
Lateral burin on oblique break	-	-	-	2	-	-	1	-	-	-	-	-	3	1%
Lateral burin on transverse break	1	-	-	5	1	-	3	1	-	-	-	-	11	4%
Medial burin on oblique break	-	-	-	1	1	-	-	-	-	-	-	-	2	1%
Transverse burin on broken edge	-	-	-	-	-	-	1	-	-	-	-	-	1	0%
Lateral burin on oblique truncation	1	1	-	4	6	-	3	-	-	1	-	2	18	7%
Lateral burin on transverse truncation	3	1	-	2	2	-	2	2	2	1	-	-	15	5%
Medial burin on oblique truncation	4	1	1	16	6	-	2	2	2	1	-	2	37	14%
Medial burin on transverse truncation	-	-	-	1	-	-	1	-	-	-	-	-	2	1%
Transverse burin on retouched edge	-	-	-	6	2	-	3	-	1	-	-	-	12	4%
Lateral atypical Lacan burin with oblique truncation	-	-	-	3	5	-	5	2	4	-	-	-	19	7%
Lateral atypical Lacan burin with transverse truncation	1	-	-	2	2	1	1	1	-	-	2	1	11	4%
Medial atypical Lacan burin with oblique truncation	3	-	1	6	5	-	2	1	-	-	-	-	18	7%
Transverse atypical Lacan burin	1	-	-	-	-	-	-	-	-	-	-	-	1	0%
Lateral dihedral burin with oblique spall platform	1	-	-	1	-	-	2	1	-	-	-	-	5	2%
Lateral dihedral burin with transverse spall platform	-	-	-	2	1	-	1	1	-	-	-	1	6	2%
Medial dihedral burin with oblique spall platform	2	1	1	5	7	-	8	1	1	-	-	-	26	9%
Transverse dihedral burin	-	1	-	10	2	-	4	-	2	-	-	-	19	7%
Multiple burin	7	-	2	15	10	1	6	8	-	3	-	-	52	19%
Total	27	6	6	85	53	2	47	20	13	7	2	6	274	100%
%	10%	2%	2%	31%	19%	1%	17%	7%	5%	3%	1%	2%	100%	

Table 53
Rekem 1984-86. Classification of burin edge types on multiple burins inventoried at the various loci.

	Locus									
Types of burin edges on multiple burins	1	4	5	6	7	10	11	14	Total	%
Lateral burin edge on oblique unmodified end	1	-	1	-	-	-	2	1	5	5%
Medial burin edge on oblique unmodified end	1	-	-	1	-	-	1	1	4	4%
Transverse burin edge on unmodified edge	2	-	-	-	-	-	1	-	3	3%
Lateral burin edge on transverse break	-	-	4	2	-	-	1	-	7	7%
Lateral burin edge on oblique truncation	-	2	2	3	-	3	1	1	12	11%
Lateral burin edge on transverse truncation	2	-	2	-	-	-	3	-	7	7%
Medial burin edge on oblique truncation	1	1	5	3	1	4	-	-	15	14%
Medial burin edge on transverse truncation	-	-	2	1	-	-	1	-	4	4%
Transverse burin edge on retouched edge	-	-	2	-	-	-	1	-	3	3%
Lateral atypical Lacan burin edge with oblique truncation	-	-	2	3	-	-	1	3	9	9%
Lateral atypical Lacan burin edge with transverse truncation	2	-	-	-	-	1	4	-	7	7%
Medial atypical Lacan burin edge with oblique truncation	-	1	1	1	-	2	-	-	5	5%
Transverse atypical Lacan burin edge	-	-	-	1	-	-	-	-	1	1%
Lateral dihedral burin edge with oblique spall platform	1	-	-	1	-	1	-	-	3	3%
Lateral dihedral burin edge with transverse spall platform	2	-	3	1	-	-	-	-	6	6%
Medial dihedral burin edge with oblique spall platform	2	-	3	2	1	1	-	1	10	10%
Transverse dihedral burin edge	-	-	3	1	-	-	-	-	4	4%
Total	14	4	30	20	2	12	16	7	105	100%
%	13%	4%	29%	19%	2%	11%	15%	7%	100%	

The 274 burins (Pl. 76-90) consist of 222 simple and 52 multiple types, and total 327 burin edges. In decreasing order, the simple burins are classified as burins on a truncation or retouched edge (N=84), dihedral burins (N=56), atypical Lacan burins (N =49), burins on a break (N=17), and finally, burins on an unmodified (unprepared) end or edge (N=16). The multiple burins (19%) bear generally two opposed burin bevels (N=43), but double burins on one end occur also (N=8). One example has 3 burin edges (Pl. 87: 15). The multiple burins combine all possible types of burin ends in similar proportions as recorded on the simple specimens (Table 53): on a truncation (N= 41), dihedral (N=23), atypical Lacan (N= 22), on a break (N=7), or with an unmodified striking platform (N=12). There seem to be no 'favourite' combinations of burin edge types on these tools. In 9 cases only, two identical 'types' of burin edges have been combined, and, perhaps most illustrative, the triple burin combines three different types: dihedral, truncation, and atypical Lacan burin edges.

At this stage of the description, it already appears that the type classes fail to represent very rigid categories. Even on a general level of division between *e.g.* truncation burins and dihedral specimens, classification 'choices' are sometimes rather arbitrary. Some of the burins with a truncation bear, for instance, minuscule (< 2mm long) 'burin-like' retouches on that truncation, struck off using the burin facet as a striking platform. Sometimes these modifications affect the dorsal surface of the blank (the facet edge) rather than the very truncation in which case they seem to serve to narrow the width of the burin facet. In other cases, however, they travel onto the proximal end of the spall scar. Strictly speaking, these burins should be counted with the dihedral group. However, in the present description, these small scars were interpreted as "tertiary modifications"[51], and such elements were classified with the truncation burins. Since these modifications may affect the negative bulb of the burin facet, it is sometimes also difficult to determine whether they were applied on a 'real' truncation burin or rather on an atypical Lacan burin (*e.g.* Pl. 80: 7).

The position of the burin facet on the blank is lateral for 46% of the burin edges, medial (oblique)

[51] Movius *et al.* (1968, 24) already touched this problem and distinguished between "truncation burin with dihedral modification" and "dihedral over old truncation", dependent of whether the dihedral spall was limited or rather dominant. In 1970, Movius and David described this phenomenon as a 'tertiary modification' of the burin tip (after the truncation and the burin blow). See also Demars & Laurant 1989, 70-71: '*burin sur troncature modifié*'. At Rekem, such 'tertiary modifications' are also observed on other burin types, which gave us another argument not to include them as criteria in the major typological classification.

Table 54
Rekem 1984-86. Burins. Position of burin facet on various burin edge types.

Spall platform type	Position of burin facet: Lateral		Medial/oblique		Transverse		Total
Unprepared	12	*43%*	9	*32%*	7	*25%*	28
Break	21	*88%*	2	*8%*	1	*4%*	24
Truncation	52	*42%*	58	*46%*	15	*12%*	125
Atypical Lacan	46	*65%*	23	*32%*	2	*3%*	71
Dihedral	20	*25%*	36	*46%*	23	*29%*	79
Total	151	*46%*	128	*39%*	48	*15%*	327

Table 55
Rekem 1984-86. Burins. Position of spall platform on various burin edge types.

Spall platform type	Position of spall platform: Lateral		Medial/oblique		Transverse		Total
Unprepared	7	25%	11	39%	10	36%	28
Break	1	4%	5	21%	18	75%	24
Truncation	15	12%	82	66%	28	22%	125
Atypical Lacan	2	3%	51	72%	18	25%	71
Dihedral	23	29%	44	56%	12	15%	79
Total	48	15%	193	59%	86	26%	327

Table 56
Rekem 1984-86. Burins. Correlation between positions of spall platform and of burin facet.

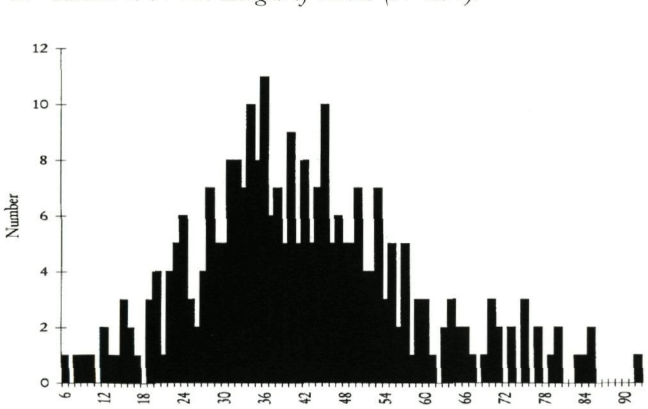
Position of spall platform	Position of burin facet: Lateral	Medial/oblique	Transverse	Total
Transverse	80	6	-	86
Medial/oblique	71	122	-	193
Lateral	-	-	48	48
Total	151	128	48	327

for 39%, and transverse for 15%. There are, however, significant differences between the various platform types: whereas almost half (46%) of the dihedral and truncation burin edges take a more or less axial position on the blank, burins on a break are mostly lateral edged angle types (88%; Table 54). This distinction probably results from the fact that breaks are mostly transverse (75%; Table 55), obliging the burin maker to detach the spall(s) along the lateral edge, since burin angles cannot be much wider than 90°. As expected, there is a clear correlation between transverse burin platforms and lateral burin facets (Table 56). Conversely, lateral burin platforms (*i.e.* along the lateral edges of the blank) are obviously correlated with transverse burins. In fact, only in the case of oblique platforms, do the burin edges actually acquire a liberty either to remain lateral edged or to travel near to the axis of the blank (with a preference of 63% for the latter). At Rekem, such oblique spall platforms dominate on most of the burin types: 72%, 66%, and 56% of respectively atypical Lacan, truncation, and dihedral burins have oblique platforms (Table 55).

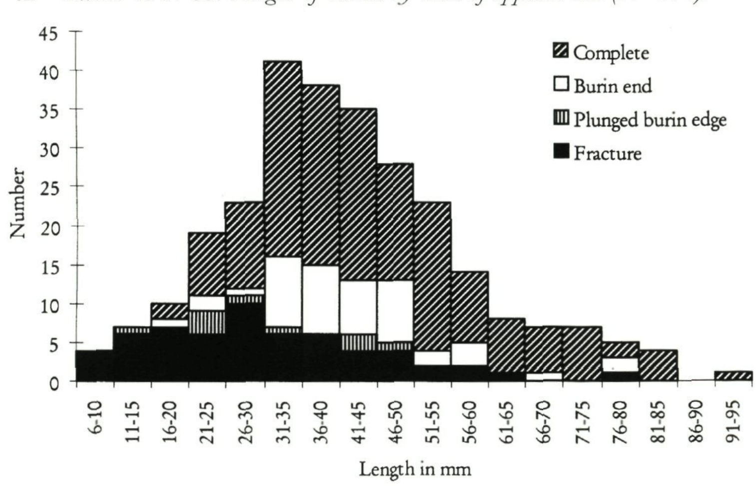
5.3.1.2 *Dimensions*

Length
Length of the burins ranges from 6 to 92mm, with a mean of 41.7 ± 16.0mm. The distribution of the measures of length shows a fairly wide, rather symmetrical spread (fig. 41). The mode is 36mm, the median 40mm. On average, the 162 burins with a 'complete' opposed end are only slightly longer than the 44 burins with opposed burin edges (45.9 ± 15.4mm *versus* 42.5 ± 12.4mm). More significantly, they are longer than the 59 broken burins (mean length of 30.9 ± 15.4mm) and than the 9 items with a plunged burin spall (mean length 31.2 ± 11.6mm). These tendencies are also illustrated in the histogram on fig. 42. Quite interestingly, there are also signifi-

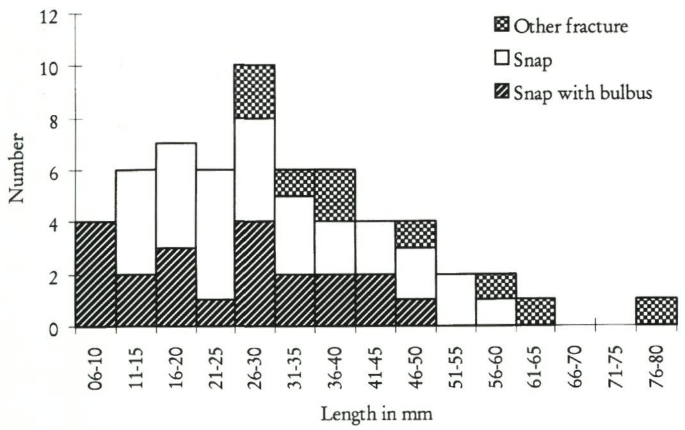
41 *Rekem 1984-86. Length of burins (N=274).*



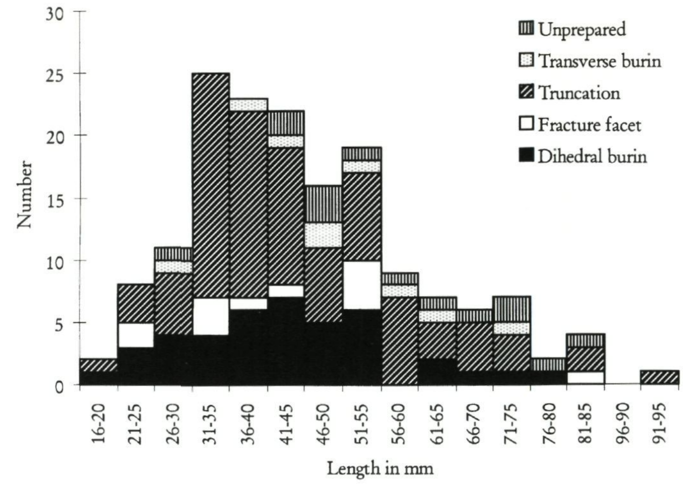
42 *Rekem 1984-86. Length of burins by state of opposed end (N=274).*



43 *Rekem 1984-86. Length of broken burins by fracture type (N=59).*



44 *Rekem 1984-86. Length of burins with complete opposed end by platform type (N=162).*



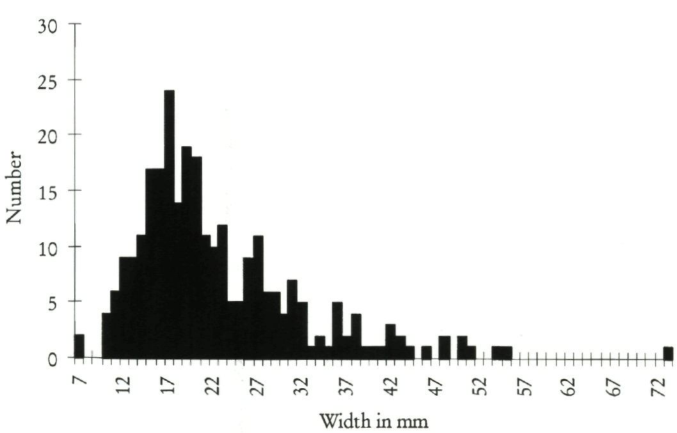
cant differences of length within the class of broken burins when fracture types are compared (fig. 43). The 21 intentionally broken burins (with a bulb of percussion in the snap fracture facet) are on average only half as long as the 'complete burins' (24.8 ± 12.5mm *versus* 45.9 ± 15.4mm). Clearly, some of the former (especially those shorter than 1 cm) should actually be regarded as a form of resharpening waste (*e.g.* Pl. 85: 3,4; see discussion below).

Concerning the burins with complete opposed end, it makes no difference whether they are on a truncation (N=86), on a break (N=12) or dihedral burins (N=41). Their mean length is always very similar (respectively 45.0 ± 15.3mm, 43.6 ± 16.8mm, and 43.5 ± 13.8mm). Transverse burins (N=9) on the other hand, and certainly burins on an unprepared end (N=14) tend to be somewhat longer (50.8 ± 13.4mm and 57.6 ± 16.1mm respectively; see also fig. 44).

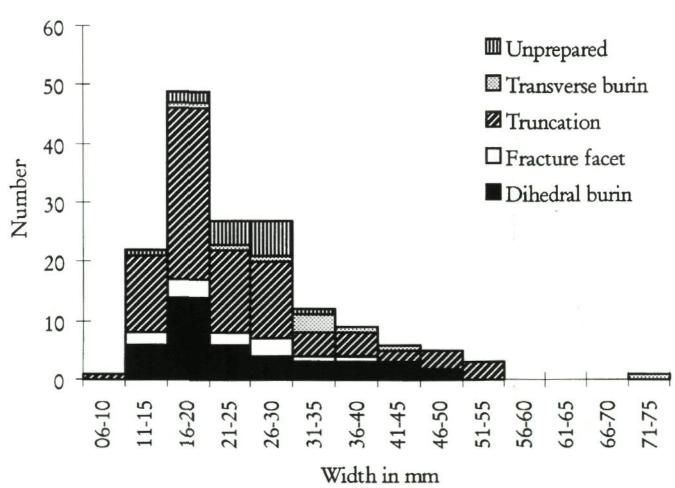
Width

Ninety percent of the burins are between 10mm and 36mm wide, but there are outliers of 7mm and until 73mm at either side of the range (fig. 45). Mean width is 22.4 ± 9.5mm, the mode is 17mm, and the median 20mm. Again, in the group of burins with complete opposed end, there are no major dimensional differences with regard to the various platform types. All types are on average about 24mm wide, with a single exception in the small group of transverse burins that includes the outlier of 73mm and has a mean width of 35.1 ± 15.5mm (fig. 46). Opposed multiple burins also do not diverge much from the specimens with an unmodified opposed end: they are on aver-

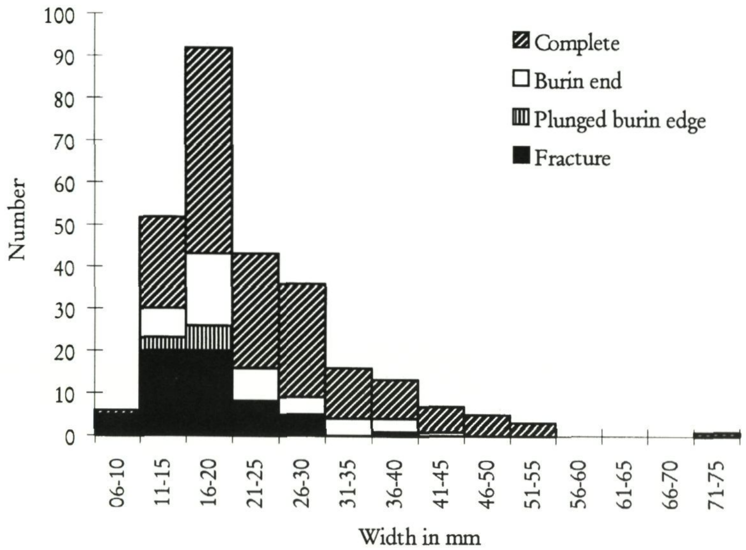
45 *Rekem 1984-86. Width of burins (N=274).*



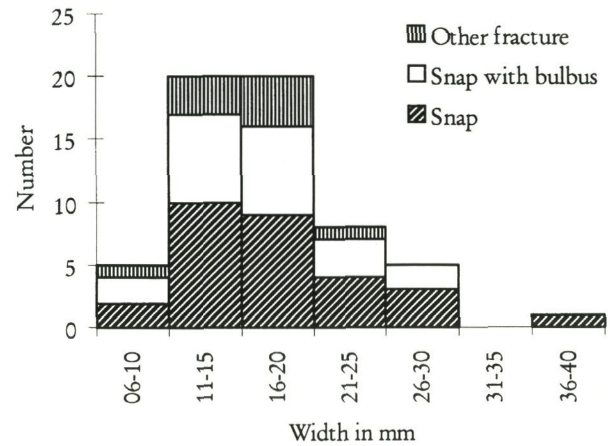
46 *Rekem 1984-86. Width of burins with complete opposed end by platform type (N=162).*



47 *Rekem 1984-86. Width of burins by state of opposed end (N=274).*



48 *Rekem 1984-86. Width of broken burins by fracture type (N=59).*

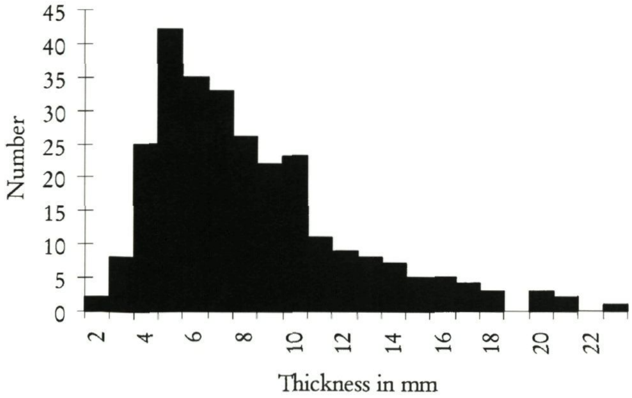


age 22.0 ± 7.6mm wide, against a mean width of 24.7 ± 10.3mm for the latter. On the contrary, burins with a plunged burin spall, as well as broken specimens are significantly narrower (mean widths of respectively 16.4 ± 4mm and 17.4 ± 6mm) than burins that preserved intact one end of their blank (see also fig. 47). Mean widths are now more similar among the various types of fracture than the mean lengths discussed above but, surprisingly, the order of magnitude has also changed. Broken burins characterised by a bending fracture with a feather, hinge, or step termination (so-called 'other fractures'; N=9) that were on average the longest elements (mean length of 46.4 ± 18mm; fig. 43) are also the narrowest specimens (mean width of 15.7 ± 4.2mm; fig. 48). Burins with a simple snap fracture and intentionally broken burins are on average 18.1 ± 6.8mm and 17.2 ± 5.4mm wide. It seems reasonable to argue that several of the 'longitudinal' bending fractures on the elongated elements were in fact provoked during production of the blanks, and thus existed before the creation of the burin edges. Possible examples, illustrated on Pl. 76: 8, Pl. 78: 13, Pl. 79: 1, Pl. 82: 10, Pl. 86: 17, show that, in a *Federmesser* context, these blanks were actually nice regular blades, particularly suitable for burin production. In those cases, knapping 'accidents' certainly did not generate formal inconvenience.

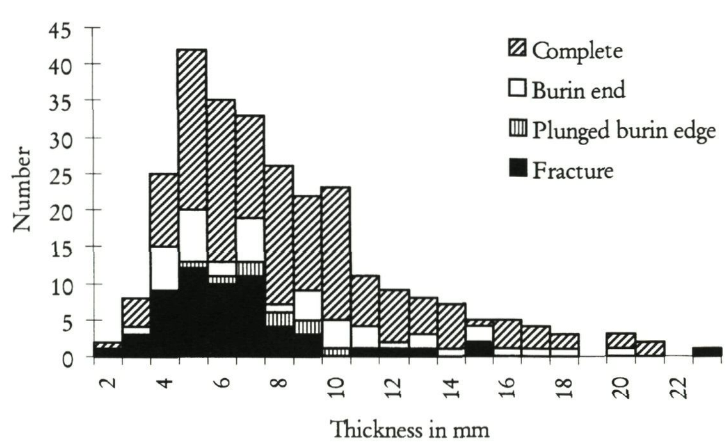
Thickness

of the burins averages 8.2 ± 3.9mm with a mode of 5mm and a median value of 7mm. The values range from 2 to 23mm, but three quarters of the burins are between 4mm and 10mm thick (fig. 49). Clearly in this case, broken burins and specimens with a plunged burin spall, many of which have 'lost' the

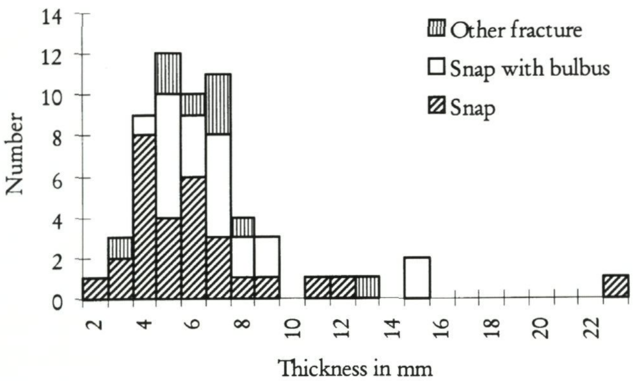
49 *Rekem 1984-86. Thickness of burins (N=274).*



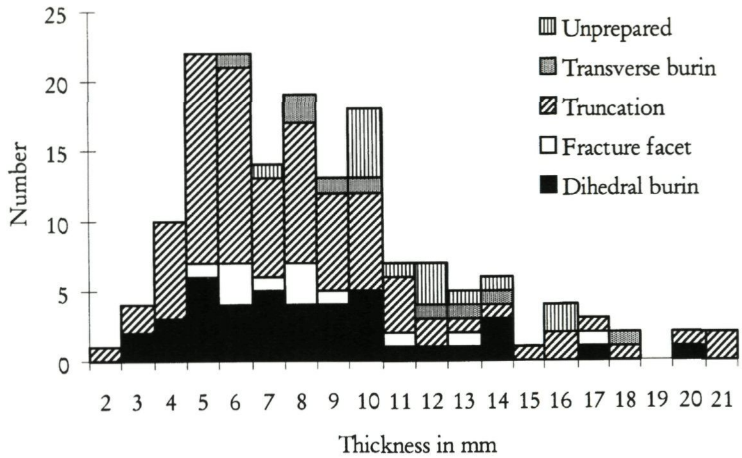
50 *Rekem 1984-86. Thickness of burins by state of opposed end (N=274).*



51 *Rekem 1984-86. Thickness of broken burins by fracture type (N=59).*



52 *Rekem 1984-86. Thickness of burins with complete opposed end by platform type (N=162).*



bulb of percussion, are somewhat thinner than the 'complete' specimens. There is, however, no difference between simple and double burins in this respect (fig. 50). Regarding the fracture types on broken burins, there appears to be a small difference between elements with a simple snap fracture on one hand, and intentionally broken burins on the other hand (mean thickness of 6.2 ± 3.9mm and 7.2 ± 2.9 mm respectively). When the outlier of 23mm with a simple snap fracture is left out of the consideration, these differences would clearly increase (fig. 51). To a certain degree they reflect the fact that these different fracture types are observed on different types of blanks. Intentional fractures are preferentially associated with a blank with a triangular cross-section (63% of the identified cases), whereas simple snap fractures are mainly observed on blanks with a trapezoid section (59%). More generally, this seems a clear indication of the voluntary application of the fracture technique in the treatment of burins, *i.e.* the use of direct percussion on the central ridge in case of thick blanks with a triangular cross-section. As we will argue below, this type of modification was precisely applied to remove such thick parts. After this procedure, the differences disappeared: burins on a break are on average just as thick as dihedral burins or burins on a truncation (fig. 52). Clearly thicker on the other hand are burins on an unprepared end and transverse burins.

Weight

I+hows that – in their state of rejection – these are not rigidly standardised tools. The heterogeneity of their volume is perhaps best illustrated by their very divergent weights. This divergence exposes a heavily skewed distribution ranging from 1g to 74g (fig. 53) and has very distinct values for various types of averages: the mode of this population is 3g, the median 6g, and the mean 9.7 ± 11.3 g. Clearly, the tools unified in this type class were made on diverse blank sizes and/or abandoned at various stages of their use-life. We will gradually explore this perspective in the following sections.

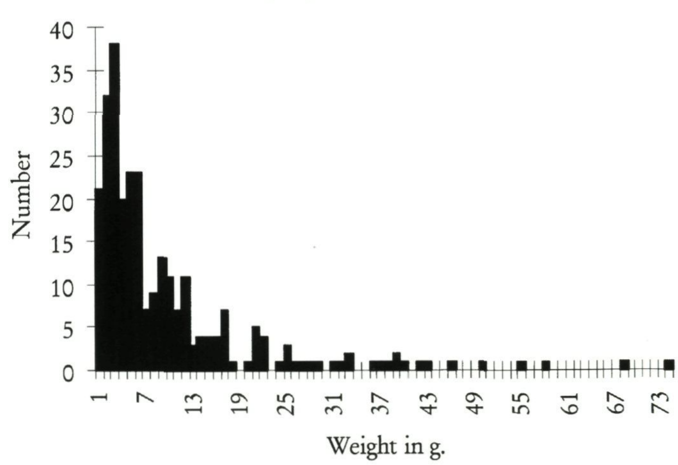
5.3.1.3 Other characteristics of the Rekem burins

After having described the various types of burin edges above, we will now provide more details and discuss some particular observations.

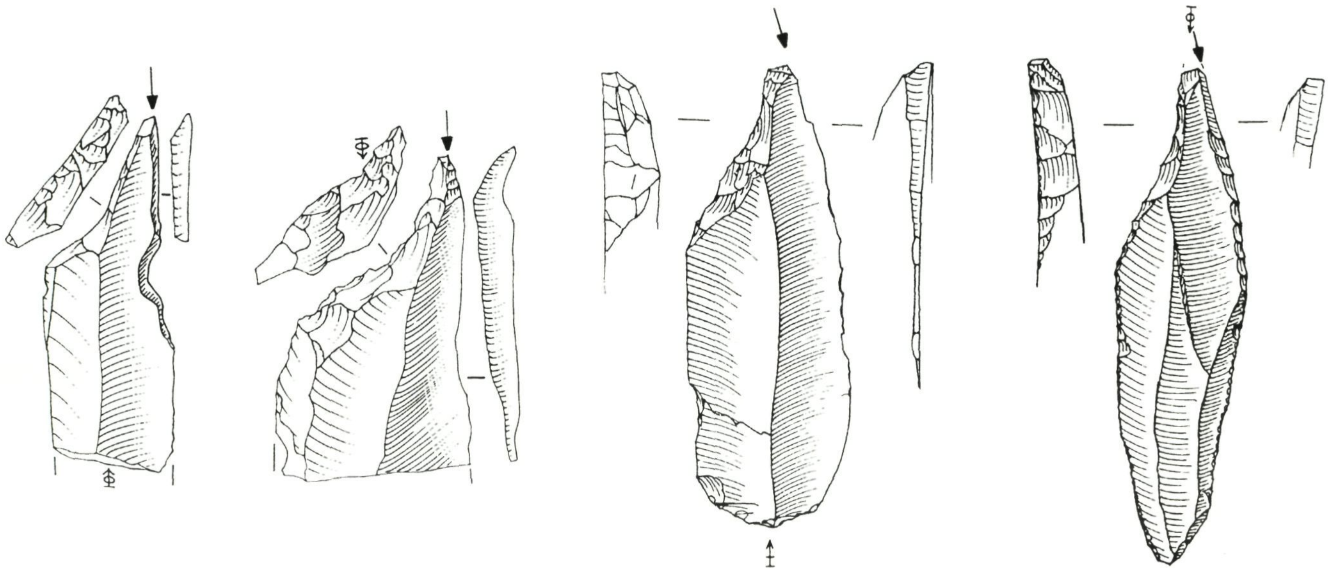
A first category that deserves particular attention, and that acts as a kind of thread in this section, are the so-called 'atypical Lacan burins', where the burin edges were truncated posterior to the burin blow (N=71). At Rekem, the general shape of this truncation is both concave and oblique on 13 elements only. According to Tixiers' definition[52], only these may actually be labelled 'Lacan burin'. But even these specimens at Rekem (*e.g.* Pl. 80: 14, Pl. 83: 4,14, Pl. 86: 5,6) clearly do not have the elongated burin bevel which is so typical of the Upper Palaeolithic Lacan

[52] *'Burin de Lacan: Burin dont la troncature concave, très oblique sur l'axe morphologique du support, est postérieure à un enlèvement de coup de burin le long d'un bord et devient presque parallèle à cet enlèvement, dégageant ainsi une saillie longue et très étroite.'* (Tixier 1978, 74).

53 *Rekem 1984-86. Weight of burins (N=274).*



54 *Lacan burins from Magdalenian Orp. Note the narrow, elongated burin bevels (from Vermeersch et al. 1987).*



types (fig. 54), where the technique seems to have been applied precisely to establish the shape of such bevels by inverting the order of modifications normally used for burins on truncation. As this explanation seems irrelevant for the Late Palaeolithic *Federmesser* burins, and is certainly not supported by the confined formal distinctions between elements that were truncated before or after the burin blow (see below), we prefer to use the term 'atypical Lacan burin' for the latter[53]. At Rekem, the origin of these 'truncated pieces with remnants of a former burin blow' may be found in the flexible and interchangeable application of spall removal and truncation techniques in the fabrication processes of burins (see below).

A third modification process – besides spall removal and truncation – that was deemed a standard procedure in preparing a burin edge platform, was the creation of a fracture facet. The dimensional analysis already suggested that the deliberate fracturing of burins occurred regularly, especially in order to remove a thicker part of the tool. This procedure frequently generated short and thick broken burins (fig. 43 and fig. 51). As the remnant part of the blank was repeatedly modified into a new burin (see refitted examples below), such deliberately broken burins may actually be considered tool waste. Some, however, were further transformed into an opposite multiple burin (*e.g.* Pl. 81: 14, refitting with proximal part Pl. 78: 11).

The morphology of the fracture facets used as striking platforms and preserved on the burins on a break, shows that many were indeed produced voluntarily. Most of these spall platforms (N=14) were created by percussion on one of the central ridges of the dorsal face of the blank (Pl. 78: 6-9,11, Pl. 81: 14,18, Pl. 82: 13,15, Pl. 83: 10); once by percussion on the ventral face (Pl. 78: 12). Three other fracture facets were even created posterior to the burin blow (Pl. 82: 9, Pl. 84: 5, Pl. 86: 9). One of the resulting burin edges was also used (Pl. 86: 9), suggesting that this procedure may also have been intentional. The few remaining breaks may be ascribed to debitage mishaps (N=2; Pl. 76: 3) or have undetermined origins (N=2; Pl. 84: 6, Pl. 85: 19). Only one fracture seems to have been caused by use, *in casu* a bec (Pl. 102: 1) which had broken midways and was transformed into a burin (Pl. 78: 10).It may finally be noted that small irregularities in the topography of some of these fractures (*i.e.* 'lips') were sometimes removed, provoking flat retouch on the ventral face of the blank (Pl. 78: 8, Pl. 81: 18).

The lateral edges of the burins are frequently modified, often at both sides. This modification generally consists of a fine continuous retouch that slightly blunted the edges but is not very invasive. It can be obverse, inverse, or (rarely) alternating. In case of truncation burins there is often a gradual transition from (oblique) truncation to marginal retouch (Pl. 76: 11, Pl. 78: 13, Pl. 80: 11,...). Refits indicate that the edges were prepared before the detachment of the primary spall (Pl. 79: 4, Pl. 80: 2, Pl. 81: 10, Pl. 82: 2,...), and that this retouch thus may have served to regularise the edge (cf. 'cresting'). On the other hand, blunting of the edges may have been advantageous during use, as these tools were probably hand-held in their 'active life' (see functional analysis). The fact that thicker blanks with a 'natural' back are less frequently retouched seems to plead for the latter interpretation. However, as these modifications are not equally present at all the loci, it also remains a possibility that they were the hallmark of certain artisans and not of others.

In general, the application of this modification implies that burin spalls are often also characterised by retouch, though sometimes only at their distal end.

[53] Following Lauwers 1988, 223.

Table 57
Rekem 1984-86. Burins. Position of final spall scar by state of opposed end; left or right according to upward burin edge.

Position of final spall scar	Opposed end: Complete		Burin edge		Fracture		Plunged spall		Total	
Proximal right	13	8%	16	18%	11	18%	1	11%	41	13%
Distal right	76	45%	28	31%	19	31%	4	44%	127	39%
Proximal left	23	14%	28	31%	8	13%	0	0%	59	18%
Distal left	56	33%	17	19%	23	38%	4	44%	100	31%
Total	168	100%	89	100%	61	100%	9	100%	327	100%

There is, however, no indication of a systematic application of 'notches' that would serve to control the length of burin spalls.

Finally, it may be noted that transverse burins often exploited a retouched edge as a spall platform (Pl. 80: 2, Pl. 84: 13, Pl. 85: 1). Again, evidence of an intentional installation of a notch in those cases is extremely scarce and in fact limited to a single example (Pl. 82: 4).

In case of 'complete' burins with an unmodified opposed end, the burin edge is preferentially situated at the distal extremity of the blank (Table 57). In only one fifth of the cases (36 of 168), was the proximal end of the blanks selected for the installation of a burin edge. Most probably, the thick bulbar part at that side generally did not allow for the creation of the desired burin edge of about 5mm wide (see below). Indeed, while blanks tend to be thicker near their proximal end, mean burin edge widths are similar on proximal and on distal burin ends (Table 58).

The proportion of proximal burin edges falls surprisingly close to the proportion of opposed multiple burins in the entire burin collection. It seems that generally the opposed proximal end of a simple burin was modified into a (second) burin edge whenever the shape and volume of the blank allowed for it. In other words, the portion of double burins can, to a certain degree, be explained as a consequence of internal technical logic and suitability more than as a 'conscious' culturally determined choice. In any case, we fail to see how the presence of double burins could be invoked as evidence for hafting procedures[54].

The terminal spall scar on the burin edges is not predominantly situated on the left or on the right side of the blank (49% *versus* 51%; Table 57). On the other hand, there appears to be a slight preference for a deviation to the left of the burin edge, relative to the axis of the blank, in the case of asymmetrical positions: 118 bevels (36%) are situated on the left half of the blank, against 81 (25%) bevels on the right half; 128 burin tips (39%) are more or less axial (Table 59). This tendency reappears at most of the larger loci of habitation zone 1. The preferential position of the burin edge on the left part of the blank is most obvious for the transverse burins, where it is represented on more than three quarters of the asymmetrical edges, and is nearly exclusive in the case of transverse dihedral burins (Table 60). It is not certain whether this pattern should be ascribed to preferences of design (*i.e.* to tradition), or rather to the right- or left-handedness of the burin user.

Table 58
Rekem 1984-86. Burins. Mean width of burin facets by position of final spall scar.

Position of final spall scar	Number	Mean width of burin facet
Proximal right	41	5.2 ± 2.8 mm
Distal right	127	5.4 ± 3.1 mm
Proximal left	59	4.7 ± 3.3 mm
Distal left	100	5.1 ± 4.2 mm
Total	327	5.2 ± 3.4 mm

Table 59
Rekem 1984-86. Burins. Location of burin tip relative to the morphological axis of the blank.

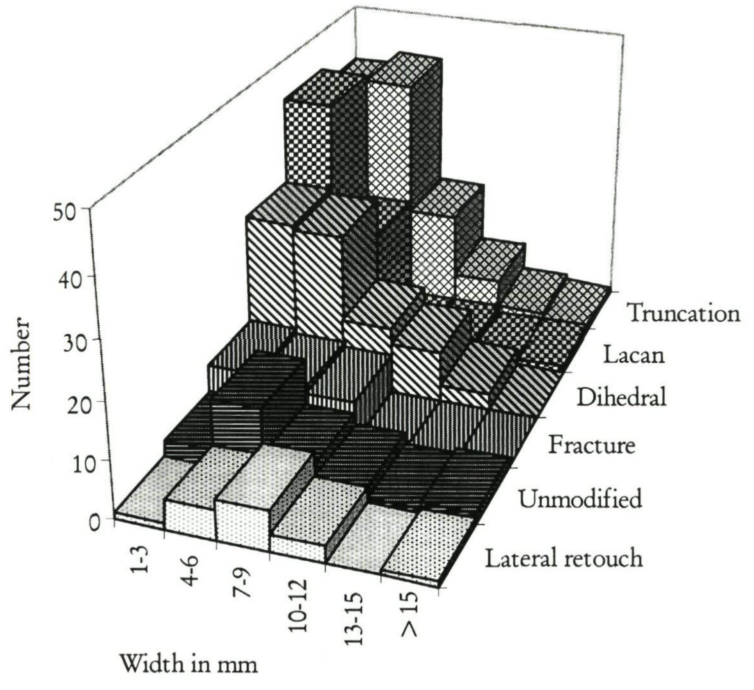
Location of burin tip	Locus: 1	2	4	5	6	7	10	11	12	14	15	16	Total	%
Symmetric (axial)	14	3	5	41	28	2	20	6	4	3	-	2	128	39%
Asymmetrical right	10	2	1	18	16	1	13	9	3	5	-	3	81	25%
Asymmetrical left	10	1	2	41	19	-	20	13	6	3	2	1	118	36%
Total	34	6	8	100	63	3	53	28	13	11	2	6	327	100%

54 As suggested by Otte 1994, 42; see further discussion in section 5.3.4.

Table 60
Rekem 1984-86. Burins. Location of asymmetrical burin tips relative to the morphological axis of the blank by type of spall platform. Medial (=axial) burins (N=128) not included.

Position of burin facet	Platform type	Location of asymm. burin tip Left	Right	Total
Lateral	Unprepared	5	7	12
	Break	11	10	21
	Truncation	27	25	52
	At. Lacan	29	17	46
	Dihedral	9	11	20
Transverse	Unmodified	6	1	7
	Break	1	0	1
	Ret. edge	10	7	17
	Dihedral	20	3	23
Total		118	81	199
%		59%	41%	100%

55 *Rekem 1984-86. Histogram of burin edge spall scar widths.*



The position of the spall scars on the blank, described in the typological section, should theoretically affect the maximum width of a burin facet. One would, for instance, expect medial burins to have broader facets than angle burins, as blanks tend to be thicker towards the centre. In some industries, where medial burins are frequently dihedral, this leads to a significant correlation between burin facet width and burin type (*e.g.* in the Magdalenian assemblages of Orp in Belgium[55] and Le Grand Canton à Marolles-sur-Seine in France[56]). At Rekem, such differentiation does not exist, at least not for dihedral and truncation burins (fig. 55), in the first place because the former are not more often medial than the latter (46% for both groups). More surprisingly, however, there seems to be no difference at all between the burin facet widths on medial burins in general on the one hand, and on angle burins on the other hand. In both cases, the facet width averages approximately 5mm.

Conversely, when mean thickness of the blanks is measured for both groups, medial burins on average appear to be slightly thinner than the lateral edged specimens (7.4 ± 3.4mm. versus 8.6 ± 4.1mm.). A more significant difference is further observed for the maximum striking platform widths of both types (on average 4.6 ± 2.5mm. for medial burins as opposed to 6.1 ± 3.3mm. for angle burins). This seems to suggest that the statement above should rather be inverted for the Rekem burins. The search for an appropriate width for a burin edge (a mean of 5mm), in combination with the thickness of the blank, codetermined to a certain degree the position of the burin edge on that blank. Evidently, the thickness of the blank always imposes a certain limit on the maximum burin edge width[57], but at Rekem, it also (partly) affected the position of the burin edges. In other words, thicker blanks were suitable for lateral burin edges, while thinner blanks were better suited for medial burins. In the case of the latter, the position of the burin edge often corresponded with the location of the principal ridge on the blank. Refitting has shown that spall removal in fact never continued beyond that ridge (see below).

In association with the width of the burin edge, the number of spall scars visible on the burin facets is also co-equal for lateral and medial burins (1.5 scars on average). In both groups, about 60% of the facets consist of a single scar, while another 30% display 2 spall removal negatives[58] (Table 61). With dihedral burins as a single exception, showing 1 scar on only one third of the burin facets, and 2 scars on almost half of the facets, a predominance of single versus double scars also recurs for all burin types (Table 62). In the case of atypical Lacan burin edges, even a large majority (61 of 71) is characterised by a single scar. This corresponds with a slightly reduced edge width (on average 3.8mm.) for atypical Lacan burins, and may most likely be explained by the fact that in several cases, a substantial part, including possible supplementary spall negatives on the 'proximal' part of the facet, were removed by the posterior truncation.

55 Vermeersch *et al.* 1987, 40.
56 Valentin 1995, 251.
57 Canting of the spall removals on the ventral or dorsal face may in some cases create an edge width which exceeds the blank thickness. At Rekem, mean burin edge width is significantly greater on flat-faced burin scars (average 10mm) than on right-angled or oblique-angled spall scars (average of 5mm for both).
At some Magdalenian sites, the width of the burin facet clearly correlates with the thickness of the blank, and as such also with the blank type (Valentin 1995, 253).
58 Transverse burin edges, on the other hand, more frequently have multiple spall scars (60%).

Table 61
Rekem 1984-86. Burins. Number of spall scars visible on burin facets by position of these facets.

Position of burin facet	Number of spall scars visible on burin facet: 1	2	3	4	5	7	Total burins	Total scars	Ratio scar/burin
Lateral	89 *59%*	45 *30%*	16 *11%*	0 *0%*	1 *1%*	0 *0%*	151	232	1.5
Medial/oblique	80 *63%*	37 *29%*	7 *5%*	3 *2%*	0 *0%*	1 *1%*	128	194	1.5
Transverse	19 *40%*	21 *44%*	6 *13%*	1 *2%*	1 *2%*	0 *0%*	48	88	1.8
Total	188 *57%*	103 *31%*	29 *9%*	4 *1%*	2 *1%*	1 *0%*	327	514	1.6

Table 62
Rekem 1984-86. Burins. Number of spall scars visible on burin facets by type of striking platform.

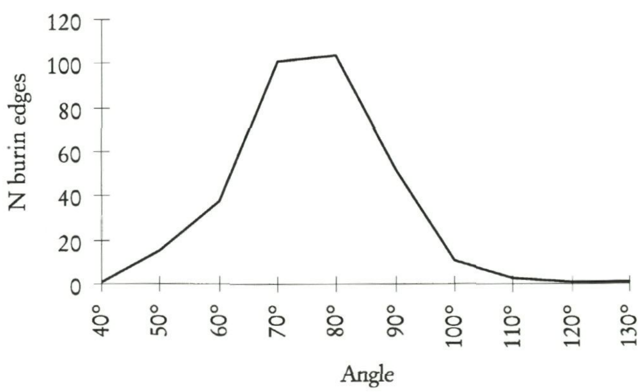
Platform type	Number of spall scars visible on burin facet: 1	2	3	4	5	7	Total burins	Total scars	Ratio scar/burin
Unprepared	12 *43%*	9 *32%*	5 *18%*	2 *7%*	0 *0%*	0 *0%*	28	53	1.9
Break	14 *58%*	6 *25%*	3 *13%*	0 *0%*	0 *0%*	1 *4%*	24	42	1.8
Truncation	73 *58%*	42 *34%*	10 *8%*	0 *0%*	0 *0%*	0 *0%*	125	187	1.5
At. Lacan	61 *86%*	8 *11%*	1 *1%*	1 *1%*	0 *0%*	0 *0%*	71	84	1.2
Dihedral	28 *35%*	38 *48%*	10 *13%*	1 *1%*	2 *3%*	0 *0%*	79	148	1.9
Total	188 *57%*	103 *31%*	29 *9%*	4 *1%*	2 *1%*	1 *0%*	327	514	1.6

In the case of dihedral burins, a similar reduction process may be invoked to explain why their 'platform' is also largely characterised by single spall scars (66 of 79), in opposition with the facets displaying the terminal scar, which show a single spall scar in only 28 of 79 cases.

The burin angle, *i.e.* the angle of intersection of the burin facet with the spall platform measured near the burin tip[59], ranges from 40° to 130°, but nearly all angles (98%) are situated between 50° and 100° (fig. 56). Almost two thirds of the burin tips have angles approaching 70° or 80°. The mean for the entire collection is 76° ± 12°. There are no major differences among the various burin edge types (fig. 57). The two outermost mean values are 74° ± 11° and 79° ± 12° for dihedral burins and for burins on a break respectively. Angles of truncation burins are situated in between. While atypical Lacan burins seem at first sight slightly sharper than 'normal' truncation burins (fig. 57), mean angle values appear to be almost identical for both groups (77° ± 15° and 76° ± 12°), mainly because of the presence of some very wide outliers in the case of atypical Lacan burins. Such wide angles of more than 100° are, in fact, only feasible if the truncation is created after the burin blow. Still, the general similarity between both groups reconfirms the non-deviating status of the atypical Lacan burins.

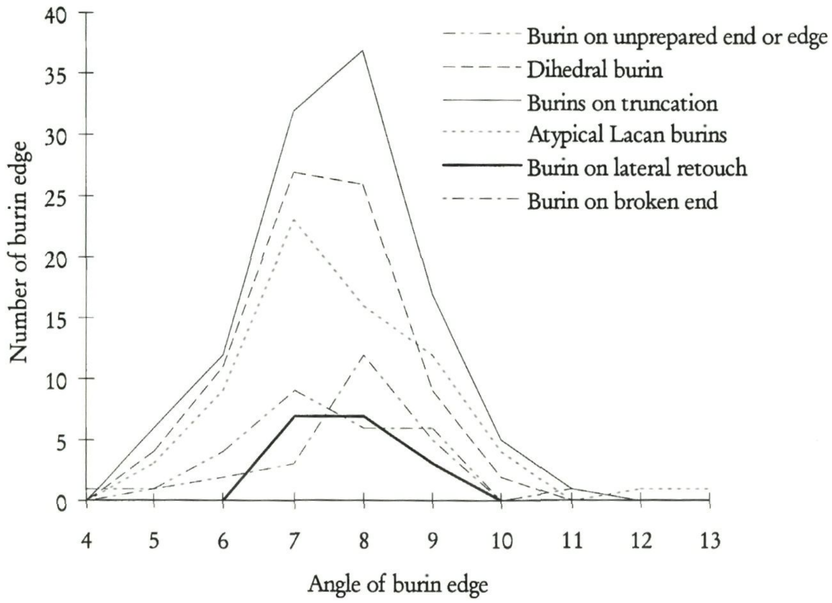
When no distinction of platform type is made, medial burins on average appear to be slightly sharper than transverse or angle burins (respectively 74° ± 11°, 75° ± 10°, and 78° ± 14°). Within the latter group, there is of course a distinction between angle burins with an oblique platform (mean burin angle = 71° ± 14°) or the same with a transverse platform (mean burin angle = 84° ± 11°; fig. 58). The shape of the platforms seems to have a certain impact as well. Burin edges with a straight platform (N= 201) are slightly sharper (74° ± 13°) than those with a curved platform outline. In fact, this pattern explains the moderate distinction between dihedral and truncation burins hinted upon above. Surprisingly, however, there is no significant distinction of mean burin angle values on burin edges presenting either a concave or a convex outline: mean burin angles on these groups are respectively 78° ± 11° and 78° ± 12°. Clearly, as stated earlier with regard to the atypical Lacan burins, no effort was made at Rekem to create nice elongated and pronounced burin bevels. It is thus hardly surprising to find little evidence of

56 *Rekem 1984-86. Angles of burin edges (N=327).*

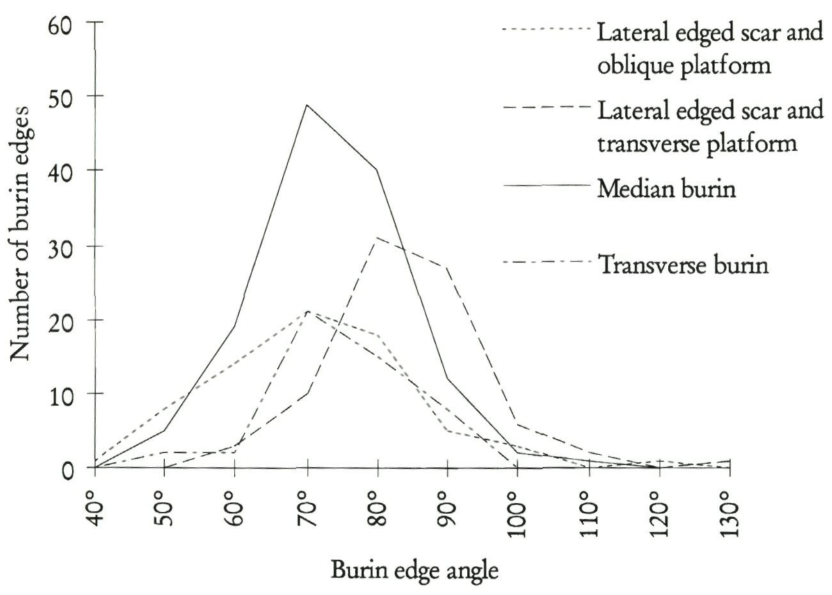


[59] Because of the reduced accuracy of this measurement, due to the conchoidal nature of flint fracture, we registered this angle in classes of 10° (see annex).

57 *Rekem 1984-86. Angles of burin edges by platform type.*



58 *Rekem 1984-86. Angles of burin edges according to the position on the burin.*



piercing activities within this tool class (see functional analysis).

The outline or overall shape of all the platforms created before (or after) spall removal is predominantly rectilinear (61%; Table 63). This is most obviously true for dihedral burins and for burins on a break, where rectilinear platforms represent respectively 87% and 79% of the identified outlines. Exceptions are, for dihedral burins, cases of overpassing spalls creating a convex platform (*e.g.* Pl. 79: 12, Pl. 81: 11) or, conversely, intentional fractures that provoked slightly concave platforms (*e.g.* Pl. 78: 6, Pl. 81: 18). Unprepared platforms are also preferentially rectilinear (71%), but there was apparently a certain interest in concave outlines as well (*e.g.* Pl. 76: 1,17, Pl. 86: 13), a shape not frequently encountered on extremities of unmodified blanks.

More variety is observed for the truncated spall platforms, which are characterised as 'rectilinear' in less than half of the cases (47%). The other truncations are, in decreasing order, concave (29%), convex (16%), a single notch (4%), sinuous (3%), or denticulated (1%). While the use of a single notch as a spall platform is still quite characteristic (*e.g.* Pl. 76: 13, Pl. 87: 5), the 'denticulated' platforms are, by contrast, curiosities (*e.g.* Pl. 83: 3). Sinuous truncations, on the other hand, are (by definition) a combination of convex and concave outlines. As the multiple burin on Pl. 76: 19 shows, this may have been literally the case on some examples (here: left a burin on truncation, right an atypical Lacan burin).

This example also brings us to a point of interest already touched upon above: are truncations posterior to the burin blow preferentially concave? At Rekem, clearly not. When outlines of 'normal' burins on truncation are compared with those of atypical Lacan burins (Table 64), the proportion of concave truncations appears to be identical for both groups (29%), and the concavity on 'normal' truncation burins is certainly not less pronounced (*e.g.* Pl. 85: 15). More surprisingly, truncations on atypical Lacan burins are more frequently convex (23% against 12%) than on 'real' truncation burins, apparently at the expense of rectilinear outlines (41% against 51%). In fact, convex outlines on 'real' truncation burins are generally not very pronounced,

Table 63
Rekem 1984-86. Burins. Shape of spall platforms by platform type.

Spall platform type	Shape of striking platform Rectilinear	Concave	Convex	Notch	Sinuous	Dentic.	Irregular	Total
Unprepared	20	6	1	-	-	-	1	28
Break	19	3	-	-	-	-	2	24
Truncation	84	52	29	7	5	2	-	179
Lat. retouch	9	2	3	1	1	1	-	17
Dihedral	69	3	6	-	-	-	1	79
Total	201	66	39	8	6	3	4	327
%	61%	20%	12%	2%	2%	1%	1%	100%

Table 64
Rekem 1984-86. Burins. Shape of spall platforms on truncation burin edges and on atypical Lacan burin edges.

Burin edge type	Shape of spall platform						
	Rectilinear	Concave	Convex	Notch	Sinuous	Dentic.	Total
Burins on a truncation (except transverse)	56	32	13	4	3	2	110
%	51%	29%	12%	4%	3%	2%	100%
Atypical Lacan burins (except transverse)	28	20	16	3	2	0	69
%	41%	29%	23%	4%	3%	0%	100%

except in a few instances, where it is not excluded that a former scraper-head might have been transformed into a burin edge[60] (Pl. 79: 1, Pl. 83: 1). Then why are convex truncations so clearly present on atypical Lacan burins? On second thoughts, such a pattern might be explained quite adequately. Starting originally from a more or less rectilinear platform, subsequent platform resharpenings during the tool's use-life that tended to emphasise the area next to the burin edge, ultimately led to a convex outline (Pl. 80: 6, Pl. 85: 2, Pl. 86: 2, Pl. 87: 7,...). In other words, instead of creating an acute burin edge angle (as on Upper Magdalenian Lacan burins), the tool in fact became blunt. If this scenario is accepted, then what might still be the advantage of a Lacan burin technique in a *Federmesser* context? One possible answer will be suggested below.

Most of the spalls (78%) were removed squarely from the burin, *i.e.* the burin facet forms an angle of more or less 90° with the ventral face of the blank (Table 65; fig. 59). Obtuse burin facets, slightly canted onto either the ventral or (occasionally) the dorsal surface, represent 17%, while 3% of the burin facets are flat-faced (only once on the dorsal face). Whereas the general hierarchy remains invariant, these percentages fluctuate significantly among the various platform types. Obtuse facets and flat-faced spall scars are more regularly observed on burins with an unmodified 'natural' spall platform and on transverse burins than on the other types. Burins on a break, for instance, never have flat-faced burin edges.

There is probably some logic behind this pattern. As a rule, the platform and spall scar are situated oppositely on top of the burin edge. In other words, the obliqueness of the former determines to a certain degree the orientation of the latter. This explains why break platforms, which are generally perpendicular to the ventral face of the burin, are most clearly associated with right-angled lateral facets. Using the unmodified extremities or retouched edges of a blank as the platform, on the other hand, stimulates the possibility of producing oblique or flat-faced burin spall scars.

Another logical consequence of this technical principle, is the fact that the burin facets on dihedral burins are canted just as frequently on the dorsal as on the ventral face; the platform in this case mirrors this equilibrium. In the case of truncation burins – because truncations are generally direct (obverse) at Rekem – the platform is slightly oblique at an angle of less than 90° to the ventral plane. In response, obtuse facets on these specimens are almost exclusively inclined onto the ventral face.

Most interesting, finally, is the fact that the burin facet obliqueness exists in manifestly different rates on 'real' truncation burins than on atypical Lacan burins. While burin facets on the former are repeatedly oblique (22%) or flat-faced (5%), on the latter they are almost systematically lateral, perfectly right-angled to the ventral plane (94%). The few exceptions can hardly even be considered as real atypical Lacan burins, as they are part of double burins on one end, in which case the posterior truncation is more associated with the adjacent truncation burin (*e.g.* Pl. 86: 16,17). In other words: burins at Rekem were resharpened to become atypical Lacan types only if the burin facet was oriented squarely on the blank. The microwear analysis has shown that burins with right-angled lateral facets were used significantly more frequently than burins with obtuse burin facets and certainly than flat-faced burins, which did not show any traces of use at all (see below). In other words, burins appeared to work most efficiently when the three facets forming the trihedral corner of a burin edge (the ventral or dorsal face of the blank, the spall platform, and the burin facet) were oriented perpendicular to each other (principle of orthogonality). At last, we may thus have found an adequate explanation for the existence of atypical

[60] Unfortunately, none of these examples appeared to be suitable for microwear determination (one is burnt, the other too much altered). In general, however, scrapers and burins are clearly separated tool categories at Rekem.

59 *Angle of the burin facet on the dorsal or ventral face of the blank. 1. right-angled (perpendicular), 2. oblique-angled (obtuse) on the ventral face, 3. flat-faced on the ventral face (burin plan).*

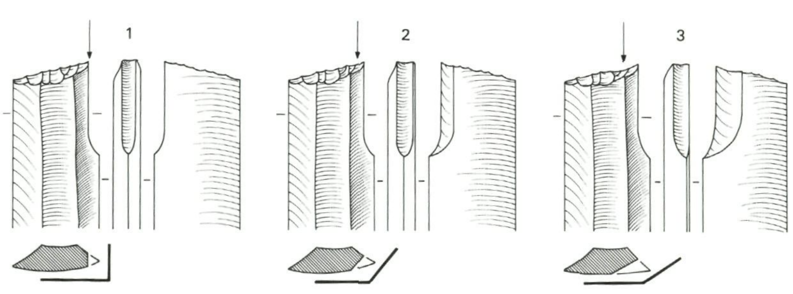


Table 65
Rekem 1984-86. Burins. Orientation of burin facet on various burin edge types:
1. Lateral (right-angled with ventral face of burin)
2. Flat-faced ventral (burin-plan)
3. Flat-faced dorsal
4. Oblique - canted on ventral face of burin
5. Oblique - canted on dorsal face of burin
6. Polyhedral ventral-dorsal

Platform type	Orientation of burin facet 1	2	3	4	5	6	Total	% lateral	% oblique	% plan	ratio dorsal/ ventral
Unprepared	16	3	-	6	1	2	28	57%	25%	11%	0.1
Break	20	-	-	3	1	-	24	83%	17%	0%	0.3
Truncation	79	6	-	22	2	1	110	72%	22%	5%	0.1
At. Lacan burin	65	-	-	3	1	-	69	94%	6%	0%	0.3
Lateral retouch	12	1	-	2	1	1	17	71%	18%	6%	0.3
Dihedral	64	-	1	7	6	1	79	81%	16%	1%	1.0
Total	256	10	1	43	12	5	327	78%	17%	3%	0.2
%	78%	3%	0%	13%	4%	2%	100%				

Lacan burins in this *Federmesser* context. An artisan who had managed to generate an appropriate right-angled lateral orientation of the burin facet onto the burin, exploited this opportunity and continued sharpening by well-controllable retouch (truncation), rather than taking the risk of introducing an inopportune burin scar obliquity with the removal of a new burin spall.

In conclusion, the appropriate orthogonal orientation of the burin facet on the burin may well have been the most crucial criterion for a burin to be suitable for use, and possibly an almost exclusive one. No other nearly as obvious pattern emerged from any other feature of these tools (see functional analysis, section 5.3.3.1). So-called tooling accidents such as hinging spalls, for instance, apparently did not at all influence the subsequent manufacturing process. Burin edges with hinged spall scars were further modified into a Lacan burin without any discrimination[61] (Table 66).

As the reader may have noticed, the burin discussion has now gradually passed from a mere description of the abandoned pieces to a consideration of the manufacturing processes. We will further focus on this aspect in the section on burin evolution with the refits as a database. Since burin spalls are crucial in that section, this category of tool waste is first presented below.

Table 66
Rekem 1984-86. Burins. Termination of final spall scars on various burin edge types.

Platform type	Termination of spall scar on burin: Straight		Hinged		Plunged		Unidentif.		Total
Unprepared	20	71%	8	29%	0	0%	0	0%	28
Break	13	54%	9	38%	2	8%	0	0%	24
Truncation	74	67%	27	25%	6	5%	3	3%	110
At. Lacan burin	42	61%	20	29%	1	1%	6	9%	69
Lateral retouch	14	82%	3	18%	0	0%	0	0%	17
Dihedral	64	81%	12	15%	2	3%	1	1%	79
Total	227	69%	79	24%	11	3%	10	3%	327

5.3.2 Description of tool waste: burin spalls

In all, 360 burin spalls have been counted at the various loci at Rekem. The great majority (74%) of these are in coarse-grained flint (269/360; Table 67), followed by elements in fine-grained variants (N=70; 19%), undetermined burnt specimens (4%), and pieces of flint type 3 or 4 (1%). Flint types could be specified in greater detail for 59% (74/125[62]) of the burin spalls refitted to a burin or to a composite tool (Table 68); 9 to fine-grained and 65 to coarse-grained variants respectively. Refitted specimens in unspecified flint types (N=51) include 15 spalls in fine-grained, and 36 in coarse-grained flint.

One third of the total population are primary spalls, generally with a triangular cross-section (Table 69). The others are classified as sharpening spalls, that display remnants of at least one former spall scar on their dorsal face and that could be secondary spalls, tertiary spalls, etc. Theoretically, this proportion implies that one burin edge would account for

[61] In general, hinging or plunging of spalls does not seem to be related with a specific platform type, except maybe for the rather frequent occurrence of hinging of spalls in case of burins on a break. As suggested earlier, such platforms are generally transverse, which normally invigorates the emergence of hinging.

[62] Not counting the spall refitting to a burin at Rekem 2, outside habitation zone 1, for which the specific flint type has not been defined yet.

Table 67
Rekem 1984-86. General flint types of all burin spalls at the various loci.

	Locus													
Raw Material	1	2	4	5	6	7	10	11	12	13	15	16	Total	%
Undetermined (patinated or heavily burnt) flint	-	1	-	9	2	-	3	1	-	-	-	-	16	4%
Fine grained grey flint traditionally called 'Hesbaye Flint'	2	1	-	16	17	-	11	17	6	-	-	-	70	19%
Coarse grained grey flint	26	2	1	113	45	1	29	18	22	1	1	10	269	74%
Mat fine grained grey flint with numerous light dots	-	-	-	3	-	-	1	-	-	-	-	-	4	1%
Translucent fine grained brown flint	-	-	-	-	1	-	-	-	-	-	-	-	1	0%
Total	28	4	1	141	65	1	44	36	28	1	1	10	360	100%

3 burin spalls on average (one primary and 2 sharpening spalls), an observation that is not incompatible with the impression gained from the refits (see below). In absolute numbers, however, there are clearly fewer primary spalls than burins. Compared with the count of burin facets, and taking into account the fact that dihedral burins normally generate two primary spalls, the ratio of primary spalls to burin edges is less than 1 to 3. In other words, about two thirds of the primary spalls seem to be 'missing' at Rekem. Even the total number of spall scars (= negatives of spalls) still visible on the burin facets (N=514; Table 61 and Table 62), which represents, of course, an absolute minimum, clearly outnumber the total amount of burin spalls that have been retrieved.

Various reasons may be invoked to explain this lack of spalls; in the first place the fact that in the excavated areas where systematic sieving occurred, the screen with 5mm mesh may not have been sufficient for the recovery of the smaller items. Secondly, a certain number of spalls may have passed unrecognised with the chips, certainly in the cases when they shattered to small fragments. Thirdly, our selection has been quite restrictive and includes 'indisputable' spalls only. Spall removals canted onto the dorsal or the ventral face of the burins, for instance, are morphologically often very similar to 'regular' bladelets[63]. It is therefore not surprising that they are somewhat underrepresented when their share is compared with the proportional count of canted burin facets on the burins (compare Table 70 with Table 65). Finally, one could argue that a large number of burins may have been introduced as finished implements into the site. This is, however, in complete disagreement with the general characterisation of the burins at Rekem as tools that were generally produced, used, and discarded locally. Still other reasons might be found to explain the disproportion of spalls to burin facets, but in general, these are unlikely to have played a major role as 'selection mechanisms'. In other words, we have good reason to believe that the 'sample' presented here is sufficiently representative for a pertinent discussion of spall types and their technological features.

This representativity is perhaps best illustrated by the fact that the occurrence of identified butt types on the burin spalls corresponds more or less with the distribution of spall platform types on the burin edges (compare Table 71 with Tables 52 and 53). About 10% have an unmodified butt, 20% to 25% are related to dihedral burins, and about two thirds have been generated from burins on a truncation. On the other hand, identifying the butt type was not

63 One small 'bladelet' could indeed be refitted onto a facet of a flat-faced burin (01c01; Pl. 90: 1).

Table 68
Rekem 1984-86. Flint types of refitted burin spalls at the various loci.
0. Undetermined (patinated or heavily burnt) flint.
1. Fine-grained 'Hesbaye' flint.
2. Coarse-grained flint.
3. Mat fine grained grey flint with numerous light dots.
4. Translucent fine-grained brown flint.
See section 4.2.2.2 for description of specific flint types by locus.
* 1 of the 4 pieces in the cell of flint type 1/21 is actually of flint type 7/21 as it refits into co-set 07c08 of Rekem 7; 1 of the 13 pieces in the cell of flint type 5/20 is actually of flint type 6/20 as it refits wit a burin of Rekem 6 (set 05s069); and the single piece in the cell of flint type 13/22 is actually of flint type 11/22 as it refits into co-set 11c05 of Rekem 11.

	Locus											
Flint type	1	2	5	6	7	10	11	12	13	16	Total	%
10	-	-	2	2	-	2	8	1	-	-		
11	-	-	5	2	-	2	-	-	-	-		
Subtotal 1	*0*	*0*	*7*	*4*	*0*	*4*	*8*	*1*	*0*	*0*	*24*	*19%*
20	3	1	13*	9	-	9	-	2	-	-		
21	4*	-	6	-	1	2	-	7	-	6		
22	-	-	-	-	-	-	4	-	1*	-		
23	-	-	5	-	-	-	-	-	-	-		
24	-	-	21	-	-	-	-	-	-	-		
25	-	-	5	-	-	-	1	-	-	-		
26	-	-	2	-	-	-	-	-	-	-		
Subtotal 2	*7*	*1*	*52*	*9*	*1*	*11*	*5*	*9*	*1*	*6*	*102*	*79%*
3	-	-	*2*	-	-	-	-	-	-	-	*2*	*2%*
4	-	-	-	*1*	-	-	-	-	-	-	*1*	*1%*
Total	7	1	61	14	1	15	13	10	1	6	129	100%

Table 69
Rekem 1984-86. Distribution of primary and sharpening burin spalls at the various loci, and ratios of spalls to burins and to burin facets.
* Burin facets of composite tools not included. Two burin facets counted for dihedral burin edges.

	Locus														
	1	2	4	5	6	7	10	11	12	13	14	15	16	Total	%
Primary spalls	14	1	-	48	19	1	16	10	11	-	-	1	2	123	34%
Sharpening spalls	14	3	1	93	46	-	28	26	17	1	-	-	8	237	66%
Total spalls	28	4	1	141	65	1	44	36	28	1	0	1	10	360	100%
%	8%	1%	0%	39%	18%	0%	12%	10%	8%	0%	0%	0%	3%	100%	
Total burins	27	6	6	85	53	2	47	20	13	0	7	2	6	274	
N of spalls/burin	1.0	0.7	0.2	1.7	1.2	0.5	0.9	1.8	2.2	-	0.0	0.5	1.7	1.3	
Total burin facets *	42	8	9	127	78	4	70	31	16	0	12	2	7	406	
N of spalls/burin facet	0.7	0.5	0.1	1.1	0.8	0.3	0.6	1.2	1.8	-	0.0	0.5	1.4	0.9	

Table 70
Rekem 1984-86. Overview of attributes and features observed on primary and sharpening burin spalls.
* left or right according to upward burin edge
** percentage calculated on number of preserved and identified features

	Primary spall (123)	Sharpening spall (237)	Total (360)	% **
State of fragmentation				
Complete	53	158	211	59%
Proximal fragment	18	31	49	14%
Medial fragment	18	15	33	9%
Distal fragment	34	33	67	19%
State of burin spall edge				
Unmodified	68	146	214	59%
Retouched	55	87	142	39%
Evidence of 'tertiary modification'	0	4	4	1%
Position of burin spall on burin *				
Proximal-right	26	13	39	13%
Distal-right	16	52	68	23%
Proximal-left	12	19	31	10%
Distal-left	13	52	65	22%
Right (without specification)	13	33	46	16%
Left (without specification)	20	27	47	16%
Unidentified	23	41	64	
Orientation of burin spall on burin				
Lateral (right-angled with ventral face of burin)	96	209	305	86%
Oblique - canted on ventral face of burin	18	17	35	10%
Oblique - canted on dorsal face of burin	4	5	9	3%
Flat-faced ventral (*burin plan*)	2	3	5	1%
Unidentified	3	3	6	
Distal end of burin spall				
Straight (feathered)	69	152	221	79%
Hinged	15	20	35	13%
Plunged	3	19	22	8%
Not preserved	36	46	82	

always evident. While 72% of the spalls have their proximal end preserved (Table 70), only 42% of the butts could be ascribed to a specific burin platform type. Especially spalls derived from burins on a break could not be distinguished confidently.

With regard to the dimensions of the burin spalls, the measurement that can be significantly compared with the observations made on the burins is the spall width which should theoretically correspond with the width of the burin facets. Indeed, for sharpening spalls a mean width of 5mm perfectly matches the earlier observations (see above). Primary spalls are on average slightly narrower (4.2mm), a logical consequence of their being positioned closer to the blank edges.

As mentioned earlier, many burin spalls show retouch on their 'dorsal' face (39%; Table 70), a modification that was seemingly applied essentially before the delivery of the first burin blow. This does not imply that it was exclusively found on primary spalls. On sharpening spalls, however, it was often restricted to the (distal) area, where it had not been eliminated by former spall removal(s). Some sharpening spalls also show 'tertiary modifications' on the facet edges (see above and footnote 1) which may possibly be related to aspects of use.

The determination of the position of the spalls on the burins corresponds also with the observations made on the burins proper (compare Table 70 with Table 57). This is both with regard to lateralisation, where identical percentages reappear (52% right versus 48% left), and also with regard to the position on either one of the extremities of the blank. Again in about two thirds of the identified cases, the spalls have been removed from the distal end of the burin.

An explanation for the slight overrepresentation of lateral burin spalls (*i.e.* right-angled with the ventral face of the burin), in comparison with the observations on the burins, has been given above. It seems, on the other hand, less obvious to explain the surplus of plunging burin spalls in comparison

Table 71
Rekem 1984-86. Burin spalls. Determination of burin types from which the spalls have been removed by locus.

Proximal end (butt) of burin spall	Locus 1	2	4	5	6	7	10	11	12	13	15	16	Total	%	% of identified
Natural surface (unprepared)	2	-	-	7	2	-	1	-	1	-	-	-	13	4%	9%
Former spall removal	-	-	-	13	2	-	8	5	4	-	-	-	32	9%	21%
Truncation	6	3	1	34	17	1	10	10	11	1	-	6	100	28%	67%
(Lateral) Retouch	-	-	-	1	1	-	3	-	-	-	-	-	5	1%	3%
Total identified	8	3	1	55	22	1	22	15	16	1	0	6	150	42%	100%
Unidentified	9	1	-	45	26	-	6	11	8	-	-	4	110	31%	
Not preserved	11	-	-	41	17	-	16	10	4	-	1	-	100	28%	
Grand Total	28	4	1	141	65	1	44	36	28	1	1	10	360	100%	

with the overpassing facets counted on the burins (22 versus 11; compare Table 70 with Table 66). Granted that plunging burin spalls probably had a better chance of being retrieved and recognised (because of their dimensions), this cannot as such explain their preponderance in absolute numbers. While several of the refits show that burins were sometimes discarded after the plunging of the spall (Pl. 78: 10, Pl. 87: 05, Pl. 88: 05), theoretically providing a one to one relation, other conjoinings suggest that advantage could be taken of such a situation in order to continue the burin fabrication on the opposite end where the plunging spall had sometimes removed the bulb of percussion (*e.g.* Pl. 82: 06). In the case of transverse plunging spalls, burin resharpening could also continue, along the same edge or perpendicularly, *i.e.* creating a dihedral burin edge (*e.g.* Pl. 79: 12, Pl. 83: 9). In none of those cases, however, has the (final) burin facet been recorded as suffering from a plunged spall scar, which might partially explain its under-representation. Finally, it may be noted that 2 plunging spalls have been refitted to burin edges on composite tools, a category not included in the present discussion.

In conclusion, in spite of a certain scarcity of burin spalls as compared with the number of burins, the analysis of this category of tool waste has reconfirmed some features observed on the tools proper. On the other hand, they allow for an invaluable reconstruction of the burin manufacture processes. We will explore this approach more systematically below. First, however, we would like to present some functional aspects of the Rekem burins and spalls.

5.3.3 The use of burins (and burin spalls)

5.3.3.1 Burins

The examination of microwear traces on the edges and ridges of all the burins provided the following results.

One third of the pieces (91/274, or 33%; Table 72) showed more or less pronounced traces of mechanical (N=86) or thermal (N=5) alteration. However, 29 of these altered pieces still permitted functional analysis, setting the total number of interpretable tools to 212 (77%).

More than half of these burins (117/212, or 55%; Table 72) presented micro use-wear, namely half of the simple burins (51%) and almost three quarters of the multiple burins (71%). Moreover, 30% (35/117) of the used elements contained more than one independent use zone (I.U.Z.): mostly two I.U.Z. (Pl. 76: 15, Pl. 79: 7), more rarely three (Pl. 77: 2), four or six (Pl. 83: 14). In three quarters of these cases (N=27), the I.U.Z were generated by distinct motions. To-

Table 72
Rekem 1984-86. Use frequency of burins and number of Intentional Use Zones (I.U.Z.)
* use percentage is calculated on the number of pieces suited for microwear analysis, i.e. unaltered elements or pieces with limited alteration that can still be diagnosed.

	Total number	N altered pieces	N suited for MW	N used pieces	% used*	N of I.U.Z. per piece 1	2	3	4	6	Total N of I.U.Z.	Mean I.U.Z./piece
Simple burin	222	76	170	87	51%	65	17	4	1	0	115	1.32
Multiple burin	52	15	42	30	71%	17	8	3	1	1	52	1.73
Total	274	91	212	117	55%	82	25	7	2	1	167	1.43

Table 73
Rekem 1984-86. Action and worked substance of various Intentional Use Zones (I.U.Z.) on burins observed on the edge or on other areas on the tool (burin facets, unmodified edges, dorsal ridges,...).
* used as fire-lighter

Area	Action	Contact material: Mineral matter	Wood	Soft animal matter	Hide	Hard animal matter	Carcass	Total N of I.U.Z.	%
Burin edge	Longitudinal	-	-	-	1	-	-	1	1%
	Graving	4*	-	-	3	97	-	104	90%
	Boring	-	-	-	1	6	-	7	6%
	Uncertain	-	-	-	-	4	-	4	3%
	Total	4	0	0	5	107	0	116	100%
	%	3%	0%	0%	4%	92%	0%	100%	
Other parts	Transverse	1	-	-	6	27	-	34	67%
	Longitudinal	-	1	1	8	5	2	17	33%
	Total	1	1	1	14	32	2	51	100%
	%	2%	2%	2%	27%	63%	4%	100%	
Total		5	1	1	19	139	2	167	
%		3%	1%	1%	11%	83%	1%	100%	

gether, 167 I.U.Z. have been counted, representing an average of 1.4 I.U.Z. per item (1.3 for simple burins, and 1.7 for multiple burins). The 'active' part of the burins was mostly situated on the trihedral corner of the burin edge (116 I.U.Z.). In other cases, use-wear has been observed on the facet edges (21 I.U.Z.; *e.g.* Pl. 76: 15, Pl. 79: 7, Pl. 80: 3), on unmodified or damaged edges of the blank (27 I.U.Z.; *e.g.* Pl. 80: 3, 83: 14) and even on dorsal ridges (3 I.U.Z.; Pl. 79: 11).

The worked material (Table 73) mainly consisted of hard animal matter (bone or antler; 83% of all I.U.Z.; Pl. 111: 5,6, Pl. 112: 1-6). Other contact materials were in decreasing order fresh/wet or dry hide, mineral matter (used as fire-lighter; Pl. 113: 3,4), carcass, undetermined soft animal matter, and wood. However, one burin only combines (Pl. 88: 7) traces of different substances.

The trihedral corners of the burin edges display a clear consistency in regard to morphology, action, and contact matter: they predominantly served to engrave bone or antler (97/116 burin bevels, or 84%; Table 73), generally producing rather narrow (2-4mm) and shallow (2-3mm) cuts with a 'V'-shape cross-section. This type of utilisation is largely independent from the burin edge type (Table 74), the width of the cutting edge (Table 75) or the burin angle (Table 76). In only a few instances did the trihedral corner serve other purposes. In the case of two large (L= ± 80mm) double burins presenting pronounced macroscopic rounding, it was used on a mineral matter (Pl. 77: 2, Pl. 85: 16), possibly as a fire-lighter[64]. In other cases, it served to cut fresh/wet hide (N=1; Pl. 78: 10) or to engrave dry hide (N=3; Pl. 77: 10, Pl. 85: 9). Seven corners, generally on rather sharp burin ends, were used for boring (*e.g.*

[64] Collin *et al.* 1991; Stapert & Johansen in press. In a former article (De Bie & Caspar 1997, 364-365), these I.U.Z. were erroneously noted as '(soft) stone graving'.

Table 74
Rekem 1984-86. Burins. Crosstable of uses for various burin edge types.
* calculation of use percentage is based on number suited for microwear analysis (MW).

Burin edge type	Total number	N suited for MW	Type of use: Cutting hide	Fire-lighter	Graving hide antler	Graving bone or	Piercing hide antler	Boring bone or bone/antler	Unidentified action on	Number used	% used*
On unmodified end	28	26	-	-	-	6	1	-	1	8	31%
Dihedral burin	79	63	-	2	1	24	-	2	1	30	48%
On truncation	110	85	-	2	1	33	-	3	1	40	47%
Atypical Lacan	69	48	-	-	-	22	-	1	1	24	50%
Transverse burin	17	13	-	-	-	8	-	-	-	8	62%
On break	24	19	1	-	1	4	-	-	-	6	32%
Total	327	254	1	4	3	97	1	6	4	116	46%

Table 75
Rekem 1984-86. Burins. Crosstable of uses and burin edge width.
* calculation of use percentage is based on number suited for microwear analysis (MW).

Width of burin facet (in mm)	Total number	N suited for MW	Type of use Cutting hide	Fire-lighter	Graving hide	Graving bone or antler	Piercing hide	Boring bone or antler	Unidentified action on bone/antler	Number used	% used*
1-3	125	93	-	1	1	33	1	4	1	41	44%
4-6	115	84	1	2	2	39	-	2	1	47	56%
7-9	51	46	-	1	-	13	-	-	1	15	33%
10-12	24	19	-	-	-	9	-	-	-	9	47%
13-15	7	7	-	-	-	1	-	-	1	2	29%
>15	5	5	-	-	-	2	-	-	-	2	40%
Total	327	254	1	4	3	97	1	6	4	116	46%

Table 76
Rekem 1984-86. Burins. Crosstable of uses and burin edge angle.
* calculation of use percentage is based on number suited for microwear analysis (MW).

Burin angle	Total number	N suited for MW	Type of use Cutting hide	Fire-lighter	Graving hide	Graving bone or antler	Piercing hide	Boring bone or antler	Unidentified action on bone/antler	Number used	% used*
< 55°	16	11	-	-	-	2	1	3	-	6	55%
55°-65°	38	21	-	-	1	8	-	2	-	11	52%
65°-75°	101	79	-	-	1	32	-	1	1	35	44%
75°-85°	104	87	1	2	-	34	-	-	2	39	45%
85°-95°	52	44	-	1	1	16	-	-	-	18	41%
> 95°	16	12	-	1	-	5	-	-	1	7	58%
Total	327	254	1	4	3	97	1	6	4	116	46%

Pl. 80: 13, Pl. 82: 2, Pl. 89: 9,11, Pl. 90: 5,6), almost exclusively hard animal matter, and once for piercing dry hide (Pl. 87: 16). The depth of penetration was generally rather limited, not reaching more than 4 to 6 mm. Finally, the action could not be specified on 4 trihedral corners.

Use zones outside the burin end principally show traces of transverse actions, again mostly on bone, but also on hide, and even on stone (Table 73). They were observed on facet edges, dorsal ridges, or on edges of the *support* (Pl. 76: 14,15, Pl. 77: 2,3,8,13, Pl. 79: 4,7,11,12, Pl. 80: 3,8,9,19, Pl. 82: 10, Pl. 83: 14, Pl. 84: 11, Pl. 85: 9,19, Pl. 86: 1,3, Pl. 87: 7, Pl. 88: 7). Evidence of longitudinal actions was present only on the lateral edges of the blanks (Pl. 76: 13, Pl. 77: 5,10, Pl. 78: 11, Pl. 80: 3, Pl. 82: 10, Pl. 84: 9, Pl. 85: 1,15, Pl. 86: 3, Pl. 87: 16, Pl. 88: 7). They worked hide, bone and antler, carcass, unspecified soft animal matter, and wood.

With regard to use-rates of the burin ends, again no significant variation appeared in relation with the cutting edge width (Table 75) or the burin angle (Table 76). There is only a slight predominance for cutting edges of about 5mm wide (56% are used in this case). Neither did the hinging (N=79) or plunging (N=11) of burin spalls substantially affect the use-rates of the burin ends (Table 77).

However, use-rates of the trihedral corners vary remarkably in the function of burin edge-type and in the orientation of the burin facet. Almost one third

Table 77
Rekem 1984-86. Burins. Use frequency of burin edges in relation to the 'distal end' of the final spall scar.
* calculation of use percentage is based on number suited for microwear analysis (MW).

Distal end of final spall scar	Total number	N suited for MW	Number used	% used*
Straight (feathered)	227	176	78	44%
Hinged	79	62	31	50%
Plunged	11	10	3	30%
Uncertain	10	6	4	67%
Total	327	254	116	46%

Table 78
Rekem 1984-86. Burins. Use frequency of burin edges in relation to burin facet orientation.
* calculation of use percentage is based on number suited for microwear analysis (MW).

Orientation of burin facet	Total number	N suited for MW	Number used	% used*
Right-angled	256	200	103	52%
Obtuse	55	40	13	33%
Flat-faced	11	11	0	0%
Polyhedral	5	3	0	0%
Total	327	254	116	46%

of the burins on unmodified end or on a break had use-wear traces. About half of the dihedral burins, atypical Lacan burins, and burins on truncation, and almost two thirds of the transverse burins show traces of use (Table 74). Flat-faced burin ends and burins with polyhedral facets are completely devoid of use-wear (Table 78). Burins with obtuse burin facets are also used less frequently than burins with a right-angled facet: respectively 33% and 52%.

Apparently, the length of the burin did not matter too much. However there is a certain preference for items between 2 cm and 6 cm long. When the complete and simple burins were exclusively measured, half of the pieces belonging to this dimensional group showed use-wear, compared with only one quarter of the burins measuring more than 6 cm (Table 79).

Not a single positive or negative trace of hafting could be detected on the analysed sample.

Finally, it may be noted that micro-polish on the burin ends is generally rather weakly developed, which indicates a relatively short period of use (at its final stage).

Table 79
Rekem 1984-86. Burins. Use frequency of burin edges on simple complete burins in relation to burin length.
* calculation of use percentage is based on number suited for microwear analysis (MW).

Length (in mm)	Total number	N suited for MW	Number used	% used*
16	1	1	0	0%
20-29	18	14	7	50%
30-39	47	35	18	51%
40-49	36	29	16	55%
50-59	32	26	11	42%
60-69	12	8	2	25%
70-79	12	10	3	30%
80-89	4	3	1	33%
92	1	1	0	0%
Total	162	126	58	46%

5.3.3.2 Burin spalls

Two thirds of the burin spalls (66%) have been analysed, namely 33% (41/123) of the primary spalls, and 83% (197/237) of the sharpening spalls. One spall out of five appeared to be affected by mechanical (N=22) or thermal (N= 27) alteration (Table 36). Three primary spalls and 19 resharpenings (10%) have conserved traces of use, generally on the trihedral corner of the parent burin, but sometimes also on a facet edge or on a portion of the lateral edge of the parent blank. These traces were clearly generated before the detachment of the burin spall. Exceptionally, spalls have been reused as borers (see section 5.6.2).

The low number of use-wear traces on the burin spalls may be partly ascribed to the presence of micro-chips on the burin bevels produced during detachment of the burin spalls by direct percussion with a hard hammer. The tiny removals may have eliminated possible micropolish on the burin edges. On the other hand, in a number of cases, the orthogonality of the burin bevel facets on the spalls was not complied with.

The types of action performed and materials worked by the spalls perfectly mirror the results observed on the burins: engraving (N= 13; Pl. 78: 2, Pl. 80: 7, Pl. 85: 8, Pl. 104: 13), boring (N=3; Pl. 79: 2), or in an undetermined motion (N=2; Pl. 80: 7, Pl. 89: 8) on hard animal matter with the trihedral corner of the burin. Four spalls were detached from burins or blanks that had previously served to scrape bone/antler (N=2; Pl. 82: 16, Pl. 85: 17), to cut fresh/wet hide (1 broken spall; Pl. 78: 10) or to split hard non-woody plants (N=1; Pl. 90: 16; Pl. 113: 1,2).

5.3.3.3 Discussion

In conclusion, the functional evidence shows that the burins at Rekem were primarily used on the trihedral corner of the burin end, as well as along the burin facets. Together, these areas carry 82% of all I.U.Z. The results confirm earlier preliminary observations[65] at the *Federmesser* site of Meer II (Belgium), and at the Magdalenian site of Verberie (France[66]). They are, however, in opposition with perceptions of other archaeologists who '*question the widespread assumption that burins are primarily a class of engraving tools for working other materials*'[67]. At first sight, the results at Rekem contrast indeed with the results obtained by P. Vaughan on the burins of the Magdalenian sites of Cassegros (France), Andernach, and Zigeunersfels[68], where only one third of the I.U.Z. were located on the burin ends and facets. The limited utilisation of these burin-specific areas was also attested in the analyses of the Hamburgian occupation at Oldeholtwolde (The Netherlands[69]), where

65 Keeley 1978.
66 Keeley in Audouze *et al.* 1981; Keeley 1991.
67 Barton *et al.* 1996, 121.
68 Germany; Vaughan 1985.
69 Moss 1988.

it has been suggested that burins would have served to facilitate hafting, for instance on composite tools[70]. The lack of use-wear traces on the burin ends at the *Federmesser* site of Niederbieber (Germany[71]) has been partly ascribed to their use being too brief to generate diagnostic use-wear. It has, however, also been suggested that burins as a tool class would have lost meaning in the *Federmesser* context[72]. At Niederbieber, as well as at most other sites, however, the analysed sample was very small. Most analyses, moreover, provide few details about the various technical attributes of these tools, and even less of their dynamic evolution, and possible uses during various stages prior to discard.

Another recurrent notion in the literature on burins is that these tools served, in many instances, as cores for bladelet production[73]. Most convincing examples can be found at the Magdalenian site of Etiolles, where backed bladelets were truly made on burin spalls[74]. At Rekem, there is no evidence to support such perspective, although two burins at Rekem 7 seem to be associated with the production of LMP at this concentration. They are seemingly obtained from the same flint nodule, to which a series of (rejected) LMP may also be ascribed. Both burins are very thick elements (produced on crests), and one of them (Pl. 84: 2) shows signs of intensive resharpening, producing dihedral facets and flat-faced burin scars, which seem to suggest that it may have been exploited as a core. Even in this (exceptional) case, however, the spalls obtained still do not fit the sizes of the blanks (generally small blades) that normally served for LMP production. At Rekem, and we believe at most other *Federmesser* sites, burin spalls are normally clearly distinct from the blades and bladelets obtained in the debitage sequences. Moreover, a third burin that also belonged to the same series produced at Rekem 7 (it actually refits), was intensively used (3 IUZ) and finally abandoned at Rekem 1 (Pl. 77: 3), showing that if any use as a core was intended, the 'tool' function still never disappeared. Other examples of burins that show morphological similarities with cores also appeared to have been used as tools (*e.g.* Pl. 81: 13: the alternative exploitation from two opposite 'platforms' in this case is very reminiscent of core reduction procedures at Rekem, yet this burin was used on bone!).

Taken together, the evidence confirms that burin spalls at Rekem are primarily waste products. The only exceptions are two borers made on burin spalls (Pl. 82: 7 & Pl. 102: 30), and the scarce microwear evidence for 'independent' use of some of these elements. None of these applications, however, has been attested in any systematic way. The traces of use-wear on the spalls were generally generated anterior to the burin blow, confirming that burins were used intermittently between manufacture and discard. In the following section, we will therefore further focus on the technical procedures that guided the 'use-life' of these tools.

5.3.4 Dynamic approach: burin evolution

After having described separately the various characteristics of burin spalls and burins in their state of rejection, it is now time for reconstruction. The following questions can be raised. How and where did these tool-types 'emerge'? What processes of shaping, modification, and use affected and 'created' them during their 'active life'? Why were they finally discarded? The 'active life' or 'biography'[75] refers to the time-span when these tools were 'conceived' (created) and 'consumed' (used and (re)modified) in the systemic context. It is our conviction that an accurate assessment of these manipulations may lead to a more acute cognition of this group of tools – as well as of lithic implements in general[76].

In their 'final form', burins have frequently preserved remnants of earlier features, testifying to some of the transformations that occurred in the course of their biographies. Examples can be found, for instance, on Pl. 82: 5, where the dihedral burin on the distal end had formerly clearly been a burin on truncation (or even a borer), or conversely on Pl. 82: 1, a burin on truncation that had previously been a dihedral type. Many more examples can be quoted which would provide a glimpse of the very flexible treatment of burins at Rekem. Most of these cases, however, do not allow for a complete reconstruction of a former state, enabling the registration of all attributes. For such information, we have to fall back on the refits.

The refit sets at habitation zone 1 comprise at present 107 burins (41%), and 128 burin spalls (36%), all types of refits included: production sequences, modifications, and breaks (Table 80, Table 81).

5.3.4.1 Burin blank production: results of dorsal-ventral refitting and flint type analysis

Altogether, 65 burins (25%) and 42 spalls[77] (12%) could be conjoined with other artefacts into debitage refits (Table 80, Table 81). By refitting the burins back in their original reduction sequence, an adequate perception of the original blanks could be acquired – information that is frequently distorted in the series of abandoned tools. The reconstructions show that, while a tendency towards the selection of

70 Stapert & Krist 1990, 387-389.
71 Plisson 1985.
72 Bolus 1992, 175. It must be admitted that burins seem to be less important in the Niederbieber tool assemblage.
73 Inizan *et al.* 1992, 72; Barton *et al.* 1996.
74 Pigeot 1987, 70; Olive 1988, 86; Olive 1992, 114 & 122.
75 Cahen 1976, 81.
76 Cziesla 1990.
77 With but one exception (in 01s44; Pl. 76: 8), all burin spalls involved in debitage refits were first refitted onto a burin or a composite tool.

Table 80
Rekem habitation zone 1. Burins. Refitting results by locus.

Refitting type	Locus 1	4	5	6	7	10	11	12	15	16	Total	% refitted
Reduction sequence	4	-	9	3	1	2	1	3	2	-	25	10%
Tooling	1	-	12	6	1	6	2	5	-	3	36	14%
Fracture	-	-	2	-	-	2	-	-	-	-	4	2%
Reduction+tooling	3	-	16	2	-	2	2	-	-	-	25	10%
Reduction+fracture	1	-	7	-	-	1	-	-	-	-	9	3%
Tooling+fracture	-	-	1	-	-	1	-	-	-	-	2	1%
Reduction+tooling+fracture	-	-	6	-	-	-	-	-	-	-	6	2%
Total refitted pieces	9	0	53	11	2	14	5	8	2	3	107	41%
Not refitted	18	6	32	42	0	33	15	5	0	3	154	59%
Total	27	6	85	53	2	47	20	13	2	6	261	100%
% refitted	33%	0%	62%	21%	100%	30%	25%	62%	100%	50%	41%	

'better' laminar elements for burin fabrication can be perceived, this selection was clearly not very rigid (see also chapter 4, and section 5.3.1). Several examples reveal a choice of quite irregular blanks, thick cortical pieces, etc. for modification, whereas more 'regular' blanks from the same co-set have sometimes been ignored.

The high rate of debitage refits, which contrasts sharply with the poor refitting evidence for lateral modified laminar pieces, suggests that burins were frequently abandoned in the area where they had been manufactured, probably after utilisation and resharpening near the same spot (chapter 6). The local character of their 'production-use-discard' cycle is further corroborated by the numerous unrefitted burins made of specific flint types, associated with – generally refitting – debitage waste material of the locus concerned (Table 82, codes 2 and 3). Notwithstanding the explicitness of this major trend, the production of burins was nevertheless not exclusively local. In fact, some unrefitted pieces are also lithologically isolated, and therefore certainly intrusive (N=5), whereas 3 other burins refit within reduction sequences generated at distant loci (Table 82, codes 6 and 7). The presence of 4 of these pieces (Pl. 84: 08, Pl. 85: 09, and Pl. 90: 05) at the dwelling at Rekem 10 may be explained by the particular nature of this locus, which possibly stimulated the introduction of extra-local elements. Two other burins (Pl. 72: 18 and Pl. 77: 3), refitted in co-sets from Rekem 7, were eventually abandoned at the dump zone in Rekem 1, where another piece (Pl. 76: 19) according to its flint type was clearly intrusive. The final specimen (Pl. 82: 10), from Rekem 6, was situated in the area that was seemingly intensively connected with Rekem 5.

Various refits also reveal the serial production of burins, with a certain tendency towards the 'monopolisation' of blanks from reduction sequences. The

Table 81
Rekem habitation zone 1. Burin spalls. Refitting results by locus.

Refitting type	Locus 1	4	5	6	7	10	11	12	13	15	16	Total	% refitted
Reduction sequence	1	-	-	-	-	-	-	-	-	-	-	1	0%
Tooling	1	-	28	13	1	10	10	10	-	-	5	78	22%
Fracture	-	-	2	-	-	1	2	-	-	-	1	6	2%
Reduction+tooling	5	-	28	1	-	2	1	-	1	-	-	38	11%
Tooling+fracture	-	-	-	-	-	2	-	-	-	-	-	2	1%
Reduction+ tooling+fracture	-	-	3	-	-	-	-	-	-	-	-	3	1%
Total refitted pieces	7	0	61	14	1	15	13	10	1	0	6	128	36%
Not refitted	21	1	80	51	0	29	23	18	0	1	4	228	64%
Total	28	1	141	65	1	44	36	28	1	1	10	356	100%
% refitted	25%	0%	43%	22%	100%	34%	36%	36%	100%	0%	60%	36%	

highest rate, for the moment, is set to 13 burins, included in one co-set from Rekem 5 (05c03[78]). In all, 33 burins[79] refit with at least one other burin in the same refit-set. These series with respectively 13, 6, 3 (2X), and 2 (4X) burins comprise very different 'types' and suggest that the type classes we use can evidently not be related to individual toolmakers in the group. Co-set 05c03, for instance, includes 4 burins on truncation, 4 dihedral burins, an atypical Lacan burin and 4 multiple burins with various types of burin edges (Pl. 78: 15, Pl. 79: 19, Pl. 80: 1,2,7, Pl. 81: 4,5,6,9,16,18, Pl. 82: 2,6). Many specimens of this block, moreover, traversed various different types in the course of their biographies (see below).

In any case, co-set 05c03 provides a very fine illustration of the serial production of burins at Rekem. On the other hand, there is plenty evidence for the association of burins with other tools in a single conjoinment (Table 83). In fact, all major type of tools have been connected with burins in this way. The functional analysis has shown that diverse tools from such compositions were occasionally employed in a similar task (*e.g.* co-sets 05c05, 05c14), although divergent traces were also observed (*e.g.* co-set 05c08; see also chapter 6).

5.3.4.2 Refitting of broken pieces and of modifications

The refitting of burins with tool waste (principally spalls) and with fragments of their blanks allowed for a detailed examination of the processes

Table 82
Rekem habitation zone 1. Origin of burin blanks as evidenced by dorsal-ventral refitting and by flint type analysis.
Legend for origin of blank:
1. Refitted in a local reduction sequence including debitage waste material.
2. Unrefitted, but debitage waste material of this specific flint type is refitting at the locus.
3. Unrefitted, but member of a specific flint type including non-refitting debitage waste material at the locus.
5. Unrefitted and member of an unspecified flint type.
54. Member of an unspecified flint type refitted in a dorsal-ventral refit lacking debitage (i.e. only with other tools).
6. Unrefitted member of a flint type lacking debitage waste material.
7. Refitted with artefacts of other locus.
74. Refitted with tool of other locus.

	Locus											
Origin of blank	1	4	5	6	7	10	11	12	15	16	Total	%
1	5	-	37	2	1	4	3	3	2	-	57	22%
2	2	-	21	7	1	5	8	5	-	5	54	21%
3	-	-	2	1	-	-	-	-	-	-	3	1%
5	16	6	24	40	-	33	9	5	-	1	134	51%
54	1	-	-	2	-	1	-	-	-	-	4	2%
6	1	-	-	-	-	4	-	-	-	-	5	2%
7	2	-	-	1	-	-	-	-	-	-	3	1%
74	-	-	1	-	-	-	-	-	-	-	1	0%
Total	27	6	85	53	2	47	20	13	2	6	261	100%

Table 83
Rekem habitation zone 1. Compilation of refit-sets in which several tools are conjoined, including at least one burin.

	Tool type							Tool
Refit-set	Burin	Scraper	Truncation	Borer/bec	LMP-Large	Composite	Retouched	total
05c14	1	3	-	1	-	-	-	5
05c08	1	2	-	-	-	-	-	3
05c05	6	1	-	-	-	1	1	9
05c01	1	1	-	-	-	-	-	2
05s063	1	1	-	-	-	-	-	2
10s50	1	1	-	-	-	-	-	2
05c03	13	-	1	-	1	-	1	16
05c12	3	-	1	-	-	-	-	4
05s098	1	-	-	1	-	-	-	2
10s49	1	-	-	1	-	-	-	2
07c06	1	-	-	-	2	-	-	3
07c08	2	-	-	-	1	-	-	3
01c01	1	-	-	-	-	1	-	2
10s48	1	-	-	-	-	-	1	2
05s064	3	-	-	-	-	-	-	3
05c22	2	-	-	-	-	-	-	2
05s066	2	-	-	-	-	-	-	2
05s068	2	-	-	-	-	-	-	2
06s54	2	-	-	-	-	-	-	2
Total	45	9	2	3	4	2	3	68

78 The 3 other tools refitted in this co-set (a large LMP, a truncated blade and a randomly retouched blade), could eventually also be interpreted as elements that originated in the context of burin use-lives (see for details sections 5.2.4.1, 5.5.2, and 5.8.2.

79 One other burin (in 01s44), refitting to a spall in a debitage refit (see footnote 77), attests indirectly of a serial production of these tools.

related to the fabrication, use, and the 'consumption' of these tools.

In all, more than one quarter of the burins from habitation zone 1 (N=66) could be conjoined with at least 1 burin spall, implying a total number of 95 spalls[80] (2 x 4 spalls, 3 x 3 spalls, 17 x 2 spalls, and 44 x 1 spall). Six spalls refitted onto 3 composite tools (1 x 3 spalls, 1 x 2 spalls, and 1 x 1 spall; Pl. 104: 12,13, Pl. 105: 2), and another 23 spalls could be conjoined sequentially with each other, constituting 8 duos, one trio, and one quartet (Pl. 90: 9-15). Altogether, the number of spalls refitted to a burin facet or to another spall amounts to 124 (35% of all spalls). Eight spall fragments, moreover, could be combined, restoring 4 broken items.

Although there was no systematic attempt to refit retouch flakes, 4 burins on truncation could incidentally be 'extended' with this type of tool waste, including 3 x 1, and 1 x 3 retouch flakes (Pl. 79: 2, Pl. 86: 10, Pl. 88: 6).

Some 21 burins could also be refitted to a (broken) fragment of the original blank. In 6 cases this consisted of another burin (Pl. 78: 1 with Pl. 78: 2; Pl. 78: 5 with Pl. 78: 7; Pl. 81: 14 with Pl. 78: 11). In 3 cases of another tool (*e.g.* the burin on Pl. 78: 10 refits with the bec on Pl. 102: 1), and once even of a plunged burin spall (Pl. 102: 30). 14 unmodified blank fragments could also be involved in these break refits.

Table 84

Rekem 1984-86. Overview of physically reconstructed phases on burins before their state of rejection.

Blank or tool type	Reconstructed phase before discard of final burin -1	-2	-3	-4	Total
Unmodified blank	8	1	-	-	9
Retouched blank	3	-	-	-	3
Truncated tool	2	-	-	-	2
Bec	3	2	1	-	6
Burin	57	36	9	2	104
Total	73	39	10	2	124

5.3.4.3 'Burin evolution'

The refitting of the burin spalls, retouch flakes and fragments confirmed that burins at Rekem are indeed a very 'dynamic' category of tool. In the course of the "use-resharpening-reuse" cycles, they could frequently be classified as different 'types'. The 73 refitted sets illustrate 124 previously unknown phases of the burins' biographies before final discard (Table 84[81]). These reconstructed forms have been codified '-1', '-2', '-3', and '-4' (*i.e.* a reverse order from the 'burin point of view', the 'abandoned form' being phase '0'). For 47% of these sets, one previous phase could be reconstructed, for 40% two, for 11% three, and for 3% four. This calculation only comprises the physically reconstructed evidence, and does not consider the numerous phases that can be perceived as 'negative' information in these reconstructions. In fact, examples show that more than 10 phases may sometimes be reproduced if such 'negative evidence' is equally included (*e.g.* Pl. 82: 6[82]).

The analysis of all reconstructed phases allowed us to trace burin 'biographies' in great detail. In the course of the various cycles of their use-life, these tools could indeed be classified into different categories.

In 9 cases, the original blank could be more or less physically reconstructed, mostly by refitting a blank fragment onto the platform of a burin on break (Pl. 89: 3,4[83]), or else in case of unprepared blanks from which a single burin spall had been removed (*e.g.* Pl. 84: 3). Some of the latter suggest that blanks may have been selected because one of their extremities directly served as a 'natural' spall platform. Such 'opportunistic' selection can also be inferred from several unrefitted burins on an unprepared end (see above). The spall platform in these cases often consists of a part of the opposed core platform that is consumed by the distal end of the blank selected for burin manufacture (*e.g.* Pl. 78: 1,3, Pl. 82: 11,12, Pl. 87: 1). Otherwise, this distal part may also be cortical (Pl. 76: 1).

Such 'thick' extremities are generally not well-suited for 'normal' burin resharpening procedures (dihedral types or truncation burins), and burins on unprepared end are therefore frequently abandoned in a very early stage (cf. their 'deviating' length, see above). The only appropriate way to further reduce these tools, is by breaking off the thicker part and continue burin fabrication on the new distal end of the remnant proximal part of the blank. Such procedure could be documented twice in the refits (*e.g.* Pl. 78: 1,2). Similar 'creations' of breaks intended to serve as burin spall platforms, were also observed on other blanks, where unmodified (surpassed) distal parts had been intentionally removed (Pl. 89: 3).

[80] Two of these spalls were later transformed into a borer (Pl. 82: 7; Pl. 102: 30), one was equally inventoried as a burin (Pl. 79: 11).

[81] These 'phases' also include some transitions to the opposite end in case of multiple burins, where the refits could help to define the successive installation of the respective burin edges.

[82] The 'biography' of this burin, fabricated on a blade, passes at least 12 stages of modification and rejuvenation: 1) preparation of the lateral edges by semi-abrupt retouches; 2) installation of a bec at the distal end of the blade; 3-6) sequential fabrication of 4 transverse burins on retouched edge at the same end (one spall refitted); 7-9) realisation of 3 dihedral angle burin edges; again one spall could be physically refitted; the distal extremity of an overpassing spall equally belongs to this series on the basis of debitage refits; it removed the bulb of percussion off the blank; 10) installation of a bec at the proximal end of the blank; at this stage, the item was a composite tool (dihedral burin & bec); 11) removal of a final spall from the proximal end, which transformed the bec into a medial truncation burin edge and the tool into a multiple burin; 12) retouch trimming of the proximal truncation burin edge, changing it into an atypical Lacan burin edge.

[83] In case of Pl. 89: 4, sequential refitting shows that the blade was in fact broken during debitage. The 'original blank' of this burin was therefore a blade fragment.

Eleven refitted phases of the tool biographies did not belong to the burin category, but to a different tool class. They were in 6 cases a bec (*e.g.* Pl. 79: 02, Pl. 88: 06, and Pl. 78: 10, refitting with Pl. 102: 1), in 2 cases a truncated piece and in three cases, finally, a randomly retouched tool[84]. The "alliance" between burins and becs, which might equally be related to the use of these tools on similar contact material, is further discussed in section 5.6.3. In general, the burin blow in some cases seems to have served as a useful technique to rejuvenate a bec (*e.g.* Pl. 79: 2).

Finally, 104 phases of the physically reconstructed burin biographies portray a 'new' burin edge. As stated earlier, these reconstructions do not necessarily represent the same type of burin edge as those preserved on the discarded item. An overview of the transitions is presented in Table 85. The following observations can be made.

Burins on unmodified ends or edges are rejuvenated into burins on break (N=2). A likely explanation for this scenario has been discussed above (*i.e.* the volume of the burin extremity did not allow for other types of modification). Conversely, transitions from other burin edge types to burin edges on unmodified end were of course only possible when the reduction turned to a 'fresh' opposite end (N=2).

There are no reconstructed transitions of burins on break into other burin types (unless, again, in case of opposite burin edges, where a transition to a truncation burin has been observed; Pl. 81: 18). On the other hand, 10 rejuvenations within this group of burins could be documented, a relatively high number, clearly challenging earlier opinions[85] who stated that "*this particular sub-type of burin tended not to be resharpened, due to the fact that the spall platform usually approximates 90°*". A transition from other burin edge types to a burin on break, could be documented a few times only, mainly concerning the earlier mentioned burins on unprepared end. It should be noted, finally, that other type of tools were occasionally broken and transformed into this burin type (Pl. 78: 10, refitting with Pl. 102: 1).

35 examples of resharpening within the group of burins on truncation could be physically reconstructed. In 29 cases, these rejuvenations did not even change the specific sub-type (Table 85). Four refits illustrate a transition to an atypical Lacan burin edge (*e.g.* Pl. 77: 01, Pl. 80: 11), while another 8 examples could be provided of truncation burin edges being transformed into a dihedral burin edge type (*e.g.* Pl. 79: 12, Pl. 81: 4, Pl. 82: 6, Pl. 83: 6, Pl. 88: 10). Conversely, several refits show transitions or transformations of other burin types (N=7), becs (N=2; Pl. 79: 2, Pl. 88: 6), and truncated tools (N=2; Pl. 78: 16, Pl. 84: 8) into burins on truncation (Table 85). In the case of the 2 atypical Lacan burins being transformed into burins on truncation, the reduction actually continued along the opposite edge on the same burin end (Pl. 77: 1, Pl. 86: 14).

Other transformations of atypical Lacan burins are poorly documented. There is, however, a nice example of a transition to a dihedral burin edge (Pl. 81: 10). The transition into a 'burin on break' just relates to a broken burin (Pl. 80: 15). Transitions within the group of atypical Lacan burins are even more poorly illustrated, which can of course be ascribed to the fact that we did not systematically attempt to refit retouch flakes onto the truncations. In reverse order, we have already mentioned the 4 truncation burins being transformed into atypical Lacan burins. In addition, another 4 dihedral burin edges were submitted to the same procedure (*e.g.* Pl. 80: 7,14).

Again, other examples of dihedral burins being transformed into other burin types are rare, and mainly relate to multiple burins. In fact the transition from a dihedral burin edge into a truncation burin edge necessarily passes through a stage of 'atypical Lacan burin edge', namely at the moment when the truncation is finished. There are, on the other hand, many refits showing a systematic resharpening of dihedral burin edges without modification of the burin type (N=18) or even the subtype (N=14; Table 85). Examples can be found *e.g.* on Pl. 80: 7, Pl. 82: 6,7, Pl. 85: 8, Pl. 87: 11, Pl. 88: 10. Several conjoinments also illustrate the transformation of other tools (*e.g.* a bec; Pl. 84: 2) or other burin types into a dihedral burin. These pieces have already been mentioned above.

Of course, and as stated earlier, these refits document only a part of the rejuvenations and transformations of the burins that took place at the site. For a start, many burin spalls seem to be lacking, and refitting results, by their nature, are always 'incomplete' (in this case especially with regard to retouch flakes). Still, they provide a sample of solid evidence in regard to the dynamic aspects of this category of tool.

Together with the results of the functional and spatial analyses (see chapter 6), the refits show that most of the burins at Rekem were clearly expedient tools that were used, rejuvenated, and abandoned at the same spot where they had been manufactured[86]. Burin 'consumers' at Rekem used three major processes to produce and to modify this type of tool: spall removal, truncation (or lateral retouch), and (transverse) breakage. In our present-day techno-typological approach, the removal of a burin spall is of course a prerequisite for a burin to exist. It was, however, not necessarily perceived as the privileged technique by the prehistoric toolmaker while transforming burins. The refits confirm that truncating was at least equally potential in a burin reduction (atypical Lacan burins), and even intentional fracturing occurred as a possible alternative (Pl. 82: 9, Pl. 84: 5, and Pl. 86: 9). Use-wear traces on the burin end presented on Pl. 86: 9 prove that breakage was not exclusively a technique for spall platform preparation, but sometimes also served to produce a "finished" item.

As these three modification techniques (spall removal, truncation, or transverse breakage) cannot be correlated with differentiated functional aspects

[84] The phases 'truncated piece' and 'randomly retouched tool' may of course represent preparatory stages only.
[85] *e.g.* by Movius *et al.* 1968, 30.
[86] De Bie & Caspar 1997, 1998.

Table 85

Rekem 1984-86. Overview of physically reconstructed transitions within the class of burins.
Bold figures represent transitions to opposite burin edge.

Initial type of tool	Tool type in next stage (after modification)																					
	Lateral burin on oblique unmodified end	Lateral burin on transverse unmodified end	Medial burin on oblique unmodified end	Lateral burin on oblique break	Lateral burin on transverse break	Medial burin on oblique break	Lateral burin on oblique truncation	Lateral burin on transverse truncation	Medial burin on oblique truncation	Medial burin on transverse truncation	Transverse burin on retouched edge	Lateral atyp. Lacan burin with oblique trunc.	Lateral atyp. Lacan burin with transv. trunc.	Medial atyp. Lacan burin with oblique trunc.	Lateral dih. burin with oblique spall platf.	Lateral dih. burin with transv. spall platf.	Med. dih. burin with oblique spall platf.	Transverse dihedral burin	Burin type not determined	Bec	Blank	Total
Lateral burin on oblique unmodified end	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Transverse burin on unmodified edge	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Lateral burin on oblique break	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Lateral burin on transverse break	-	-	-	-	6	-	-	-	-	**1**	-	-	-	-	-	-	-	-	-	-	-	7
Lateral burin on oblique truncation	-	-	-	-	-	-	8	-	2	-	-	1	-	**1**	-	-	1	2	1	-	-	16
Lateral burin on transverse truncation	-	-	-	-	-	-	1	3	1	1	-	-	1	-	-	-	-	-	-	-	-	7
Medial burin on oblique truncation	-	-	**1**	-	-	-	-	1	12	-	-	-	-	1	-	1	2	1	-	**1**	-	20
Transverse burin on retouched edge	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	1	-	-	-	-	-	7
Lat. atyp. Lac. burin with oblique trunc.	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	**1**	-	-	-	-	-	2
Lat. atyp. Lac. burin with transv. trunc.	-	-	-	-	-	-	-	**2**	-	-	-	-	-	-	-	-	-	1	-	-	-	3
Med. atyp. Lac. burin with obl. trunc.	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Lat. dih. burin with transv. spall platf.	-	**1**	-	-	**1**	-	-	-	-	-	-	1	-	**1**	-	3	1	1	-	-	1	10
Med. dih. burin with oblique spall platf.	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	4	-	-	-	-	6
Transverse dihedral burin	-	-	-	-	**1**	-	-	**1**	-	-	-	1	-	-	1	1	-	7	-	-	-	12
Burin type not determined	-	-	-	-	-	-	-	-	2	-	-	1	1	-	-	1	-	3	-	-	-	8
Bec	-	-	-	-	1	-	-	-	2	-	-	-	-	-	-	-	1	-	-	2	-	6
Blank	1	1	-	-	3	-	-	1	-	-	-	-	-	-	-	-	-	2	-	-	1	9
Retouched tool	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	3
Truncated piece	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Total	1	2	1	4	14	1	10	10	19	2	7	6	2	4	1	8	9	17	1	3	2	124

(section 5.3.3.1), the question arises what actually motivated the knapper in making a choice. Fracturing has been observed on just 7% of the burin ends. Spall removal (24%) and especially the creation of a truncation, before (38%) or after (22%) the burin blow, are definitely more regular techniques. In fact, these procedures consume less raw material than breakage (an appropriate rejuvenation by spall removal or truncation reduces the blank with just 2mm or 3mm). Breakage may consume up to about half of the length of the burin (Pl. 78: 2,9) and is principally used to eliminate thick parts of the blanks (*e.g.* overpassing distal ends) that one can hardly otherwise shape. Therefore, one element that may have influenced the technical choice of the artisan, was the actual volume of the part of the artefact that was to be modified.

The predominance of truncations over spall removals must probably be explained otherwise. In fact, the former procedure probably allows for a better shape control, and induces less risk. As shown by the atypical Lacan burins, one of the major concerns of the artisan when producing burins must have been the preservation of orthogonality between the faces that form the burin bevel (section 5.3.1.3). Removal of new spalls could always disturb this condition and possibly also introduce other tooling accidents.

The refits also allowed us to measure the impact of the successive rejuvenations on the burin length. The mean length of the blanks was reduced by about 3 cm from the most completely reconstructed items (phase -4; 73 ± 5mm) to the ultimately abandoned tools (phase 0; 43 ± 15 mm). Certain dihedral and atypical Lacan burins have refitted spalls that reveal a deviation of about 2cm between the final burin phase and the proximal end of the refitted spall (*e.g.* Pl. 81: 9,10). One can of course postulate the existence of a large number of intermittent phases between the 'original' burin and the discarded implement. If truncation and spall removal were employed accurately to refresh the worn burin ends, these tools potentially had a prolonged use-life.

Finally, the exploration of the 'evolution' of the burins illustrates that the actual form of these tools, in the sense of present-day typology, is largely determined by the precise moment of abandonment. That is, if one wants to explain variability in burin typology (rather than just describe it), one has to consider the question of why burins were actually discarded.

5.3.4.4 *Discard of burins*

It is generally acknowledged that stone tools are discarded when they break or are worn out, and when rejuvenation is not considered worth the effort[87]. We would add that they may also be dismissed in the case of tooling accidents; when the artisan fails to (re)achieve the appropriate 'active part' or 'particular design'; or simply when a tools' task is accomplished.

Intensive use on bone and antler (see functional analysis) quickly reduces the sharpness of flint edges. At Rekem, insufficient efficacy of the trihedral corner must have been the principal functional argument for abandoning a burin (end). On a techno-morphological level, burin end inefficiency was not directly related to the width of the cutting edge[88], nor to the variation in the burin angle[89], nor to tooling accidents affecting the distal end of the burin blow (hinging or plunging spalls[90]). Functional efficacy appears to be primarily related to the orientation of the burin facet with regard to the (ventral) face of the blank: burins with flat-faced or obtuse facets were generally abandoned without being used (see functional analysis). Refits show, however, that burin ends in this case could also be repaired (*e.g.* Pl. 79: 5), and thus that the tool as a whole was not necessarily discarded at once. In fact, inappropriately oriented burin facets were observed even more frequently on reconstructed burin ends (27%) than on abandoned items (22%).

Another potential cause of burin end inefficiency was the occurrence of very small secondary scars affecting the trihedral corner. This damage was occasionally induced by the hammer in the act of the burin blow. It certainly degraded the sharpness of the trihedral corner and its ability to carve into bone or antler. Again, however, rejuvenation was still possible to prolong the tools' use-life.

The refitting results suggest that there were, however, certain limits to rejuvenation. Spall removal, for instance, when it 'travelled' from the lateral edges to the tool's centre, never crossed the principal ridge of the blank. Exceptionally, a radical solution was the delivery of a transverse burin blow from the opposite edge (*e.g.* Pl. 79: 11,12), but such procedure inevitably induced a considerable reduction of length. On the other hand, burin makers tended to avoid thick parts of the blanks. In cases of thick *supports*, the burin bits were continually placed toward the edges (see above). Burin edges on (thick) proximal ends were also scarce. Certain burins, therefore, were probably discarded as soon as the remnant part of the blank became too thick.

Finally, the length of the burin (blank) could definitely play a role in the rejection decision making, taking into account that pieces shorter than 30mm can normally not be handled easily when used unhafted, as seems to have been the case at Rekem. This probably explains the sudden decrease of complete burins shorter than 30mm (fig. 42 and fig. 60). On the other hand, some very small burins have been utilised well until complete exhaustion, especially in case of rotary actions (*e.g.* Pl. 80: 13).

In conclusion, various converging causes have contributed to the abandonment of burins. They mainly consisted of an interplay of functional aptitudes (*e.g.* burin facet orthogonality, type of action), and technical modalities (*i.e.* rejuvenation opportunities). As stated above, other possible causes may have also contributed. As the most obvious expedient tools at Rekem, burins were hardly curated (transported) or kept apart for successive tasks. Many,

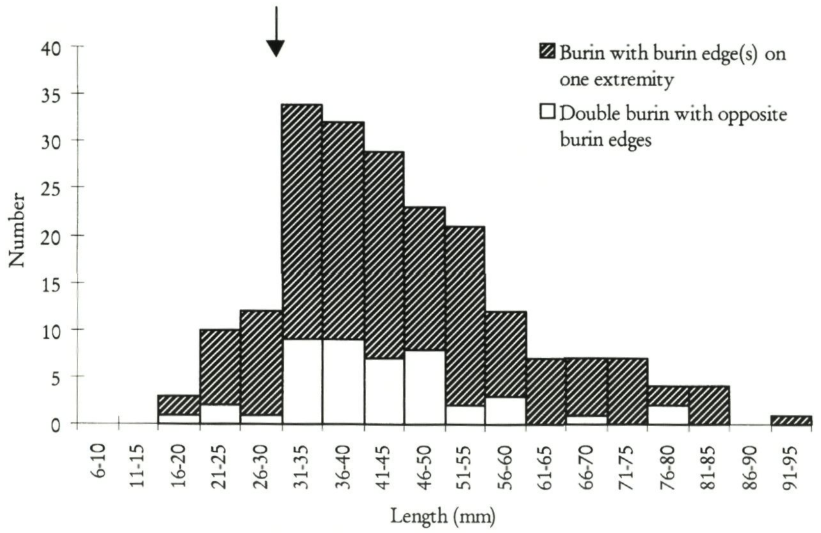
87 Barton *et al.* 1996, 119.

88 See functional analysis: there is no significant variation in use type or use-rates regarding various cutting edge widths. Nor does this measure change significantly in the course of the various rejuvenated phases (refits).

89 See again functional analysis for absence of variation in use type and use rate. A comparison between the angles of abandoned burins and angles measured on refitted examples again fails to reveal significant differences.

90 Burins that suffered from hinging or plunging spalls were also used (see functional analysis) and occasionally rejuvenated (*e.g.* Pl. 78: 2, Pl. 79: 13). Sometimes, the artisan also exploited the distal part of a plunging facet as the striking platform for a new burin blow (*e.g.* Pl. 82: 6). On the other hand, plunging spalls could reduce the length of the burin considerably, which as such may have accelerated disposal.

60 *Rekem 1984-86. Length of complete burins.*



therefore, may have been abandoned just because the task for which they were created was accomplished, or because the artisan left the working area for whatever reason, even if the burins were still potentially efficient or might be successfully rejuvenated.

By way of exercise, we tried to specify why the final products of each of the 73 refitted sets might have been dismissed. In less than one quarter of the cases, abandonment could be ascribed to dimensional aspects: burins became too short (N=8) or too thick (N=10) to be rejuvenated beneficially. Another (small) part clearly suffered from inappropriate spall scar orientation (N=9), and some items had broken (N=5).

In most cases (N=41), however, we failed to discern why these tools were dismissed. A considerable number (N=22) suffered from plunging or hinging spalls, but in general, these tooling accidents could have been repaired successfully. For several simple burins, one could also question why the artisans did not attempt to exploit the opposite end. In general, it seems that most burin (ends) at Rekem were clearly abandoned before exhaustion.

In conclusion, determining specific causes of abandonment on individual burins is not evident, and some causes are still archaeologically invisible. Moreover, what seems to have been a cause of discard in certain instances (*e.g.* tooling accidents), appears to have been subject to 'repair' on other occasions. Once more, so it seems, are we witnessing a major lack of 'consistent ruling' in this assemblage, an observation that may again be related to the prevalent flexible attitude of *Federmesser* artisans in their treatment of flint, a property likewise observed in the general knapping procedures during debitage (chapter 4).

5.3.5 Discussion

5.3.5.1 Stylistic significance of burin types

In a recent article on burins, Barton *et al.* noted: "*It is generally assumed by many archaeologists that variability in burin morphology is primarily stylistic in origin – that is, representing culturally determined variants of more or less functionally-equivalent tools. As such, burins are widely used as markers of temporal change and cultural identity*"[91].

Indeed at Rekem, the quasi-systematic employment of burins as gravers on hard animal matter, whatever their techno-morphological "types", at first sight seems to support the idea that the making of these tools was guided by factors that exceeded functional demands. As such, burin forms would constitute an expression of "style", and reveal culturally determined choices.

However, close examination of the refits clearly showed that the artisans at Rekem were not steered by rigorous mental templates while manufacturing these tools. There was apparently no tenacious ambition to obtain a specifically designed end-product. On the contrary, typological distinctions are primarily a result of complex and versatile sequences of (re)sharpening, co-directed by functional demands, maintenance potential and causes of discard. While the disclosure of these dynamics may provide an apprehension of the general practices performed by the group at issue, and thus expose its (technical) traditions (its way of doing things), typological inventories, conversely, exclusively reflect the states of abandonment of these tools. By nature, such inventories generally fail to unveil possible design standards that might have prevailed in the primary phases of the tool biographies.

Some recurrent patterns at Rekem suggest that such 'design standards' (*i.e.* the earlier mentioned 'mental templates'), occasionally still played a role after all, at least during the stage of initial manufacturing. There is, for instance, this pair of atypical Lacan burins, both manufactured on cortical blades with retouched edges, and with the burin end situated on the proximal right angle of the blank (Pl. 88: 3,4). They represent the only tools of the small knapping spot at Rekem 15 (section 6.2.1). Both were refitted back to their production sequence, and microscopic examination indicated that they were totally devoid of use-wear traces. Combined technological and spatial analyses showed that a single individual at Rekem 15 reduced some nodules during a short period of time, and manufactured both these tools. The formal similarities suggest that the artisan adhered to a certain scheme in doing so, and thus that these "initial" products may indeed reflect (individual) "stylistic" preferences.

A second example concerns the 13 burins of different "types" from co-set 05c03 (section 5.3.4.1). In 12 cases, the blanks were retouched on both edges before the delivery of the (first) burin blow. Such modification might represent the 'signature' of a

[91] Barton *et al.* 1996, 123.

single artisan at work here, although it may also be related to technical constraints, to prehension, or to task-specific aspects.

In other refits also, one may sometimes perceive a certain 'signature', although it is not always easy to translate this in explicit descriptions. In co-set 05c05, for instance, the burins are mostly made on notoriously thick blanks, including a heavy tabular flake, which gives them a rather crude appearance (Pl. 79: 2,5, Pl. 80: 3, Pl. 81: 13,14). Again, however, they represent various formal 'types'.

In conclusion, if multiple factors contributed to the ultimate 'layout' of the burins, it seems that the origin of the manifold 'types' resulted primarily from a combination of functional and technical eventualities that steadily affected the artefact's performances, rather than from a mental template. In other words, there was a conscious aspiration on the part of the artisan to produce a preconceived form. The fabrication of these tools was steered by the same opportunistic, flexible, and versatile attitudes that governed the debitage technology (see chapter 4). It was characterised by successive adaptations to morphology, volume, classic properties of the raw material etc. and, in the case of the burins, also functional demands (*e.g.* a perpendicular orientation of the burin facet). A major lack of rigorous 'programming' urged the artisans to make expedient choices and devise elementary but propitious solutions at any one moment of the tools' life history. While such (technical) behaviour appears quite characteristic of the *Federmesser* artisans at Rekem, it is also worth recalling what Binford already stated 25 years ago. "*Items produced expediently and discarded in the immediate context of use exhibit less investment from the individual standpoint and hence have less of the identity of the manufacturer expressed through individualised and group conscious, 'stylistic' characteristics*"[92].

Burin typology is probably, therefore, a poor guide for comparative studies of 'style' in *Federmesser* assemblages.

5.3.5.2 Burins in the Late Palaeolithic of NW Europe

Whereas references to other sites have been occasionally integrated in the text above, we will now explore more systematically how our observations on the burins from Rekem relate to investigations at neighbouring sites; 'neighbouring' both from a chronological and a geographical point of view (*i.e.* Late Palaeolithic in NW Europe, see chapter 1). Unfortunately, there are not yet many (published) sites that allow for accurate comparisons of burin 'dynamics'. In fact, sites where typological, technological, functional, and spatial approaches have all been closely combined are still rare. Examples of sites where at least part of these methods have been used, are known from Belgium (*Federmesser* site of Meer, Magdalenian sites of Orp and Kanne), Northern France (Magdalenian and *Federmesser* sites of the Paris Basin and the Somme Valley), Germany (Magdalenian and *Federmesser* sites of the Neuwied Basin), Great Britain (site of Hengistbury Head), and the Netherlands (Hamburgian site of Oldeholtwolde). One should be fully aware that disparities in regional research programs inevitably contribute to biases in our knowledge.

A first remark can be made concerning the numerical importance of burins in the Late Palaeolithic of NW Europe. A predominance of this tool group, often in competition with backed pieces, is frequently attested in Late Magdalenian assemblages where scrapers are generally less numerous. A slight predominance of burins over scrapers is also encountered in most Creswellian assemblages of the British Isles[93], and in numerous (early) Hamburgian sites on the NW European plain[94].

Many *Federmesser* sites in NW Europe display the same characteristic. Burins outnumber scrapers, for instance, in Belgium at Meer II[95] and Meer IV[96], in the Southern Netherlands at Milheeze and Oostelbeers[97], in France at Dreuil-lès-Amiens, Amiens-Etouvie, Ecourt-Saint-Quentin, Hangest-sur-Somme III.1, Saleux, etc.[98] and in Germany at Klein-Nordende A[99]. However, the opposite pattern (*i.e.* scrapers outnumbering burins) is certainly equally frequent, and has been noted at most *Federmesser* sites of the Neuwied basin[100], in the Northern Netherlands and Northern Germany, and also at most Azilian sites in SW Europe.

Given their dynamic character, it is hardly surprising to find major dimensional differences in the various burin populations of Late Palaeolithic NW Europe. A cursory reading of the literature high-lights that the average lengths range from more than 70mm at the Magdalenian assemblage of Marsangy I[101] to less than 30mm at the *Federmesser* assemblage of Niederbieber II[102]. Clearly, these differences may be primarily ascribed to very distinct traditions of blank production and selection: burins are almost exclusively made on blades in Magdalenian contexts, but manufactured on a wide range of blank types in *Federmesser* assemblages. However, blank selection is definitely not the only factor at work. It fails to explain, for instance, why Magdalenian burins at Gönnersdorf (on average less than 40mm long[103]), are shorter than those at most *Federmesser*-sites in Northern France (*e.g.* an average length of almost 60mm at Dreuil-lès-Amiens[104]). Raw material availability and transport constraints certainly played a major role as well, and gave rise to "*un air de gigantisme*"[105] in areas where large good quality flint nodules were abundantly available in the immediate surroundings. Conversely, when a substantial (sometimes major) part of the lithic material had to be transported over long distances[106], the tools can be observed to 'shrink', irrespective of cultural tradition or transport modalities (nodules, prepared cores, blanks, or finished implements).

Finally, the question remains as to what degree various rates of burin rejuvenation played a role in dimensional variability. At Marsangy I, resharpening

92 Binford 1973, 243.
93 But not at Hengistbury Head (Barton 1992).
94 Burdukiewicz 1986.
95 Van Noten 1978.
96 Otte 1994.
97 Arts 1988.
98 Fagnart 1993; Coudret 1995.
99 Bokelmann *et al.* 1983.
100 Bolus 1992.
101 Schmider n.d.
102 Bolus 1992.
103 Veil 1983.
104 Fagnart 1993.
105 Fagnart 1993, 254.
106 Floss 1994.

procedures were rather limited[107], and hardly reduced the length of the tools. However, this is certainly not a general feature of Magdalenian burins. Intensive resharpening has been attested for instance at Etiolles and at Orp where burins were shown to have been intensely reduced.

Regarding the percentages of various burin types, the Late Magdalenian assemblages of NW Europe seemingly manifest regional diversity[108], with a predominance of dihedral burins at most of the Magdalenian sites of the Paris Basin (except for some units at Etiolles[109]). This is also so in the Belgian cave sites. However, a majority of truncation burins (including Lacan types) has been counted in the open-air sites of the Neuwied Basin and in the Loess region of NW Belgium and the Southern Netherlands. In Creswellian and Hamburgian assemblages, burins also mostly originate from truncations rather than being dihedral[110]. At Hengistbury Head, dihedral burins are reported to make up one half of the burin assemblage, but the author included many burins on break in this category[111].

Although there is also considerable variability in the *Federmesser*-assemblages with regard to the burin types, so far no equivalent regional patterns can be outlined. At most *Federmesser*-sites with a representative number of tools, truncation burins generally dominate dihedral specimens. When attention was paid to atypical Lacan burins, these types are also systematically reported, *e.g.* in Belgium[112], and in Northern France[113]. At Niederbieber, the author did not mention their presence[114], nor were they noted during our examination[115]. However, some atypical Lacan burins seem to be attested at the more recently discovered Rhineland site of Kettig (pers. comm. M. Baales). In general, *Federmesser* assemblages in the Rhineland are characterised by a definite scantiness of dihedral burins[116]: at Niederbieber I and IV there is a distinct predominance of burins on truncation, while the *Federmesser* level at Andernach contains a majority of burins on break.

Another particular feature at Niederbieber relates to the position of the burin edges on the blanks. While burin ends at Rekem (and at most other representative *Federmesser* assemblages where this information has been recorded) are predominantly shaped at the distal end of the blanks, at Niederbieber I proximal and distal shaping occurs in more or less equal numbers. There is also the tendency at Niederbieber IV towards a preference for shaping at the proximal end[117]. Interestingly, a balance between proximal and distal burin ends was also observed at the nearby Magdalenian site of Gönnersdorf[118] while the burins of the Magdalenian open-air sites in Belgium were again preferentially manufactured on the distal ends[119]. Before hazarding to conclusions of continued regional traditions, based on such detailed observations, one should of course first intensively explore any possible alternative explanations. One such rationale has been proposed by S. Veil[120], who concluded that burins at Gönnersdorf were essentially made on medial blade fragments. Artisans therefore had no interest in distinguishing between proximal and distal ends (if indeed they were capable of doing so). While the author relates this practice to hafting[121], it is also conceivable that the scarcity of local raw materials may have played a role. At sites where good lithic material had to be brought in over long distances[122], the transport of medial blade fragments must have been advantageous[123].

It is, however, unlikely that similar arguments may be invoked to explain the balance between proximal and distal burin ends at Niederbieber. A systematic use of blade fragments, as "*Grundform*" for burin production, is by no means demonstrated for this assemblage. On the contrary, compared with Rekem, an even wider range of unstandardised flakes and 'waste products' (trimming flakes, crested blades, and even residual cores) seems to be employed for burin manufacture at Niederbieber. In this case, apparently, raw material 'stress' urged the artisan to exploit very diverse objects. As a further result, there may have been a preferential choice of items with an 'appropriate' proximal end, in order to preserve distal ends for other type of tools (especially scrapers).

At Kanne and Orp[124], at Gönnersdorf[125], and at many Magdalenian assemblages in Central Europe[126], almost all burins on truncation have the burin blow on the right-hand side[127]. It has been suggested that this pattern may be ascribed to prehension modalities during manufacture[128]. While truncation burins are equally dominant in *Federmesser* lithic inventories, comparable explicit tendencies in these assemblages are unknown to us. At Rekem, there is a balance between left-edge and right-edge burin blows.

107 Schmider n.d., 134.
108 It cannot be excluded that this diversity might (also) have a chronological significance, if one accepts early dates for sites like Etiolles, Gönnersdorf, and Orp.
109 Interestingly, at Etiolles U5, all 'imported' burins (*i.e.* on exogenous flint) were on truncation, while there was an equilibrium between truncation and dihedral burins in the series that was produced locally (Pigeot 1987, 70).
110 Jacobi 1988; Burdukiewicz 1986.
111 Barton 1992, 113.
112 Vermeersch 1976; Van Noten 1978.
113 Fagnart 1993.
114 Bolus 1992.
115 In May 1994.
116 Bolus 1992, 175.
117 Bolus 1992, 121.
118 Veil 1983.
119 Vermeersch *et al.* 1987, 40.
120 Veil 1983, 271-272.
121 Medial blade fragments have perfectly parallel edges (Veil 1983, 270).
122 Floss 1994.
123 To the contrary of this argument, it should be noted that there are also many proximal burin ends in sites with abundant local raw material (*e.g.* at Etiolles P15, at Verberie,...).
124 Vermeersch & Symens 1988, 245.
125 Veil 1983, 284.
126 Bosinski & Hahn 1972.
127 At Gönnersdorf, this is also supported by the observations on the burin spalls (Veil 1983, 299).
128 Bosinski & Hahn 1972, 131.

Another distinction between Magdalenian and *Federmesser* practices is related to the selection of blank types for burin manufacture.

In the Paris basin, Magdalenian burins are almost systematically made on a selection of 'better' blades, obtained during generations of '*plein debitage*' production[129]. The artisans generally preferred relatively thick and narrow blades[130] but not necessarily the longest items. In fact, the very divergent sizes of the original flint nodules and the resulting diversified blade lengths at the various settlements (compare Etiolles with Pincevent) had only limited repercussions on the final implements. The (average) length of the burins in the various assemblages is always very similar[131]. Seemingly, blank selection for tooling was not only directed by morphological 'archetypes', but also by dimensional ideals[132]. Unlike for the scrapers, somewhat thicker (more robust) blades were regularly exploited for burins. Since the thickness of the blades in that case could be correlated with burin edge width, the latter dimension occasionally presents a bimodal distribution in these assemblages[133].

In the *Federmesser* sites of the Paris Basin, these two tendencies are equally reported: 1) specimens with rather narrow burin bits made on light-weight laminar blanks and 2) heavier specimens, made on robust (laminar) flakes with larger burin bits[134]. However, unlike Magdalenian series, *Federmesser* burin series generally present a dimensional continuum, rather than a dichotomy. In fact, this 'conglomeration' nicely reflects the wide range of blank types employed for burin fabrication which has already been reported for the Neuwied basin (see above) and fully confirmed by the observations made at Rekem. The (increasing) indiscriminate use of all sorts of blanks is obviously induced by the dissolving differentiation between blades and flakes in *Federmesser* reduction sequences.

Another notable difference between Magdalenian and *Federmesser* lithic economies concerns the organisation of blank procurement for burin production (as well as for other tools).

At the Magdalenian site of Verberie, the authors observed that "... *débitage et mise en oeuvre des supports correspondent à des moments complètement séparés de la vie de l'habitat*[135]." Similar observations were made at other sites where intensive refitting has been performed, for instance at Pincevent[136] and Etiolles[137]. Intentional 'caching' of blades in these contexts is a general practice that accompanied this type of blank management[138]. In fact, one could argue that a form of logistical strategy, presumably also conducted by the Magdalenians on a regional scale, persisted in the economical organisation inside the settlements, where highly skilled competent flintknappers provided other group members with the bulk of necessary blanks. Several exceptions to this practice have been noticed[139], but there is a general tendency for the procurement and consumption of blanks in these sites to appear as separate activities.

In *Federmesser* sites, conversely, a rupture in the *chaîne opératoire* between blank production and tool 'consumption' is much less demonstrable[140]. On the contrary, (domestic) tools were frequently made on the spot of use by the same artisan who subsequently either consumed his/her 'personal' blanks for tooling or immediately shared them with his/her neighbours. While various levels of knapping quality can be discerned at Rekem (chapter 4), there is no clear evidence of specialised knappers who might have worked for the group as exemplified by intensive distributions comparable to those observed at Pincevent[141]. Direct evidence of the higher mobility of burins at Rekem is limited to a few tools that were manufactured on blanks obtained at 'LMP-workshops' (Rekem 7), and that were possibly 'influenced' by the LMP 'mobility' (see chapter 6). Moreover, both the blank producer and the burin manufacturer in these cases were likely to have been the same person. On the other hand, a certain degree of opportunistic 'scavenging' of suitable blanks by other group members can certainly not be excluded, but there is no indication that exclusively high quality blades were selected in these cases. In short, if the autonomous procurement of high quality blanks by independent specialists (still) occurred in *Federmesser* settlements, it was certainly not a major socio-economic strategy. Intentional storing of blades in these contexts, to our knowledge, has never been demonstrated.

In view of such diverse practices, one could expect that series of burins refitting in the same co-set would occur more regularly at *Federmesser* sites than in Magdalenian contexts. At the present state of refitting at Rekem, burins are indeed most frequently refitted with 'colleagues' in the same reduction sequence: 33 burins form 8 series, ranging from 2 to 13 burins (see above). On the other hand, burins could also be associated with other types of tools in a single conjoinment. Not surprisingly, however, the 'other tools' in those cases are repeatedly borers, becs or truncations. Moreover, the diverse tools belonging to such compositions were often used on the

129 Audouze *et al.* 1988.
130 Valentin 1995, 373.
131 Audouze *et al.* 1988, Fig. 6; Valentin 1995, Fig. 92-93.
132 "*On peut donc poser l'hypothèse qu'il existe des archétypes pour les outils magdaléniens qui sont caractérisés non seulement par des traits morphologiques particuliers mais aussi par un gabarit. Et ces archétypes déterminent les choix faits au moment de la sélection des supports laminaires.*" (Audouze *et al.* 1988, 67).
133 Valentin 1995, 373.
134 Valentin 1995, 530.
135 Cahen in Audouze *et al.* 1981, 136.
136 Bodu 1996.
137 Pigeot 1987; Olive 1988.
138 Compare Pigeot 1987, 76: "*Il est probable que la production de supports autonomes ait été le facteur déterminant du débitage [...], les meilleurs produits laminaires ayant été mis de côté.*"
139 At Pincevent, level IV20, beside the production of burins on blades from 'specialised' blade cores, some artisans also manufactured burins on 'self-made' poorly knapped products. Some burins, finally, were also made on the primary generations of blades from cores that were otherwise specifically meant to generate a bladelet production (Bodu 1996).
140 Compare Cahen *et al.* 1980, 218: "*A Pincevent, la préparation de supports autonomes est clairement attestée tandis qu' à Meer, la chaîne est fréquemment continue jusqu'à l'outil.*"
141 Bodu 1996.

same substance (*e.g.* burins and scrapers used on either hide or bone). In only two occasions have different worked materials been registered in a single refit (co-set 05c08 and set 05s063). In one of these cases (05s063), the burin was found at Rekem 5, while the scraper had been abandoned at Rekem 6, at a distance of more than 12 m, suggesting that other dynamics such as curation, borrowing or 'scavenging', may have been at work here.

Although comparative data are at present only sporadically available, preliminary comparisons can already be made with other sites in this regard. For the *Federmesser* tradition, our conclusions partially echo the results obtained at Meer II[142]. For the Magdalenian, evidence is growing as well. At Verberie, a few indications of serial burin production have been reported. In general, however, this site suffers from a general 'monotony' of burins (and becs). At Etiolles, there were also some indications of serial production (*e.g.* co-set N160: 7 burins, 1 borer) but mixed series have also been reported (*e.g.* co-set N261: burin, scraper, truncation). In all, this site equally seems highly specialised. On a spatial level, however, the burins were widely scattered: "*si l'on imagine que cet outillage spécialisé, monofonctionnel ou polyfonctionnel, a été employé au cours d'un travail précis (qui a pu subordonner le débitage des supports), on ne peut que constater l'éparpillement final de ces outils*"[143]. Such spatial distribution might suggest a certain "conservatism" in regard to utilised items, a practice that seems to be largely lacking at the *Federmesser*-sites.

This provisionally concludes the burin discussion which, evidently, has not been exhaustive. Many other aspects can still be dealt with. However, our short comparative overview already suggests that, whereas simple quantitative inter-assemblage comparisons based on Late Palaeolithic burin typology might fail for elucidating 'cultural' variability, the dynamic character of these tools opens promising perspectives for future comparative work.

5.4 Scrapers

5.4.1 Description of 'abandoned tools'

With 170 pieces, scrapers are numerically the third category of tool at Rekem, but absolute and relative numbers vary considerably at the different units (Table 34). Almost 60% (99 pieces) were collected from the two concentrations Rekem 5 and 6 (Table 86).

In addition to 12 heavily burnt scrapers (7%), and a few elements in flint types 3 (N=3) and 5 (N=1), more than half of the scrapers are made of coarse-grained grey flint (code 2), the others in various fine-grained variants (code 1; Table 87). Inside habitation zone 1, the flint type of 46% of the identifiable scrapers could be specified in detail, *i.e.* for 21 tools in fine-grained flint types, for 46 in coarse-grained

142 Van Noten 1978.
143 Pigeot 1987, 89.

Table 86
Rekem 1984-86. Classification of scraper types inventoried at the various loci.

Type	Locus 1	2	4	5	6	7	8	10	11	12	14	16	Total	%
Simple long endscraper on blade (L>=2W)	1	1	1	6	6	-	-	1	-	2	-	1	19	11%
Simple long endscraper on blade with retouched lateral edges	-	-	-	-	-	-	-	-	-	-	1	-	1	1%
Simple short endscraper on blade (L<2W)	-	-	-	5	4	-	-	-	-	1	-	-	10	6%
Simple endscraper on broken blade	2	-	-	6	6	-	1	1	1	1	-	1	19	11%
Simple endscraper on broken blade with retouched lateral edges	-	-	-	-	-	-	-	1	-	-	-	-	1	1%
Total blade scrapers	*3*	*1*	*1*	*17*	*16*	*0*	*1*	*3*	*1*	*4*	*1*	*2*	*50*	*29%*
Simple endscraper on flake	4	1	-	18	14	3	-	3	5	9	2	6	65	38%
Simple endscraper on flake with scraperhead covering >1:3 of edges	2	-	-	7	3	-	1	-	-	1	2	-	16	9%
Double endscraper on flake	-	-	-	1	-	-	-	-	-	-	-	-	1	1%
Simple thumbnail-scraper (L and W <2.5 cm)	-	-	-	4	1	1	-	-	-	1	1	-	8	5%
Simple thumbnail-scraper with scraperhead covering >1:3 of edges	-	-	-	-	1	-	-	-	-	-	-	-	1	1%
Double thumbnail-scraper	-	-	-	-	-	-	-	-	-	1	-	-	1	1%
Simple endscraper on broken flake	-	-	-	10	5	-	1	-	-	2	-	4	22	13%
Simple endscraper on broken flake, scraperhead covering >1:3 of edges	1	-	-	1	1	1	-	-	1	1	-	-	6	4%
Total flake scrapers	*7*	*1*	*0*	*41*	*25*	*5*	*2*	*3*	*6*	*15*	*5*	*10*	*120*	*71%*
Grand total	10	2	1	58	41	5	3	6	7	19	6	12	170	100%
%	6%	1%	1%	34%	24%	3%	2%	4%	4%	11%	4%	7%	100%	

variants. The flint type of the other 31 fine-grained and 48 coarse-grained specimens could not be further differentiated.

Although we did not (yet) attempt to refit scraper retouch waste, we will in this section again try to reconstruct the complete '*chaîne operatoire*' of these tools, touching upon aspects of manufacture, use, and abandonment, *i.e.* their 'performance' inside the settlement.

5.4.1.1 Typology

In our classification, a first-level distinction has been made between scrapers on blades and on flakes, although we immediately recognise that identifying the original blank of the abandoned specimens was not always obvious. Further criteria covered in the general classification are the (relative) sizes (short or long blade scrapers, flake or 'thumbnail' scrapers), the number of scraper-heads (simple or double), the state of the *support* (broken or not) and the possible presence of retouch on the lateral edges. Other attributes, including all the functional data, have been registered in annex.

A clear majority (71%; N=120) are end-scrapers on flake, including 28 end-scrapers on broken flake, and 10 thumbnail-scrapers with maximum length and width < 2.5 cm. Only 2 flake scrapers, one of thumbnail size, have double scraping edges (Pl. 94: 1, Pl. 97: 17). Circular scrapers are completely absent. On 23 specimens, however, frequently with a circular general outline, the scraper-head covers more than 1:3 of the total edge extent. Flake scrapers dominate or at least parallel blade scrapers at every single concentration (Table 86).

Long end-scrapers on blades (L>2W) hardly represent 12% (N=20). The same amount (N= 20) are end-scrapers on broken blades, while another 6% (N=10) are what we have called short blade scrapers. They seem to be made on blades, but as a result of (re)sharpening, their length is reduced to less than twice their width. Double end-scrapers on blades are completely lacking.

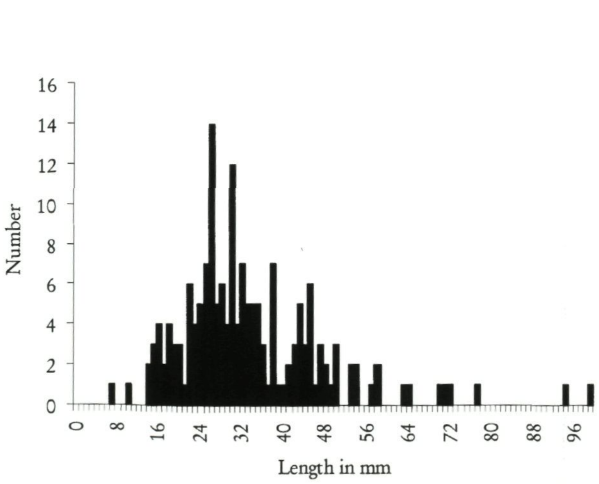
Table 87

Rekem 1984-86. Flint types used for scraper manufacturing at the various loci.
0. Undetermined (patinated or heavily burnt) flint.
1. Fine-grained 'Hesbaye' flint.
2. Coarse-grained flint.
3. Mat fine grained grey flint with numerous light dots.
5. Fine-grained 'opaline' flint.

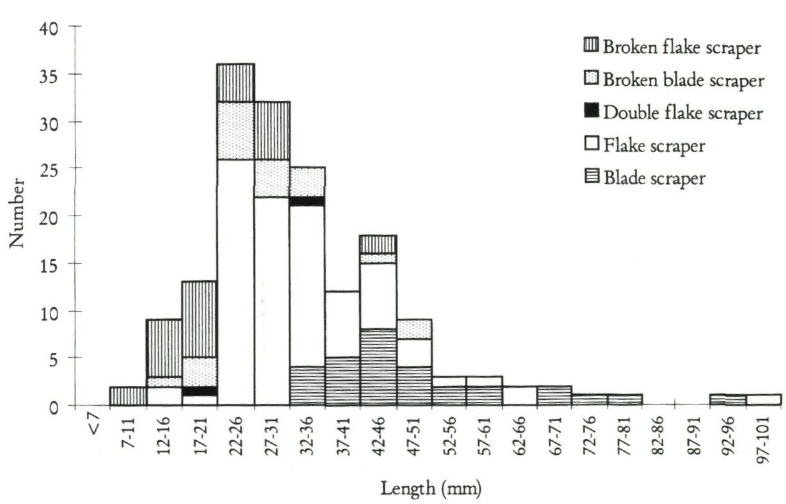
See section 4.2.2.2 for description of specific flint types by locus.
*1 of the 2 pieces in the cell of flint type 6/11 refits with a burin of Rekem 5 (set 05s063).

	Locus													
Flint type	1	2	4	5	6	7	8	10	11	12	14	16	Total	%
0	*1*	-	-	*1*	*5*	*1*	-	*1*	*1*	-	-	*2*	*12*	*7%*
10	2	-	1	8	14	-	1	-	3	-	3	2		
11	-	-	-	14	2*	-	-	-	-	3	-	-		
12	-	-	-	-	-	-	-	-	-	2	-	-		
Subtotal 1	*2*	*0*	*1*	*22*	*16*	*0*	*1*	*0*	*3*	*5*	*3*	*2*	*55*	*32%*
20	6	2	-	10	18	1	2	3	1	3	3	4		
21	-	-	-	19	-	2	-	-	-	-	-	-		
22	-	-	-	3	-	1	-	-	-	-	-	-		
23	-	-	-	1	-	-	-	-	2	2	-	1		
24	-	-	-	-	-	-	-	-	-	7	-	3		
25	-	-	-	-	-	-	-	1	-	2	-	-		
26	-	-	-	-	-	-	-	1	-	-	-	-		
27	1	-	-	-	-	-	-	-	-	-	-	-		
Subtotal 2	*7*	*2*	*0*	*33*	*18*	*4*	*2*	*5*	*3*	*14*	*3*	*8*	*99*	*58%*
3	-	-	-	*1*	*2*	-	-	-	-	-	-	-	*3*	*2%*
5	-	-	-	*1*	-	-	-	-	-	-	-	-	*1*	*1%*
Total	10	2	1	58	41	5	3	6	7	19	6	12	170	100%

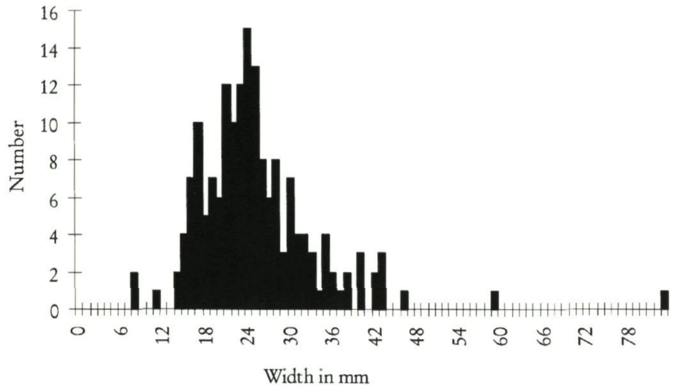
61 *Rekem 1984-86. Length of scrapers (N=170).*



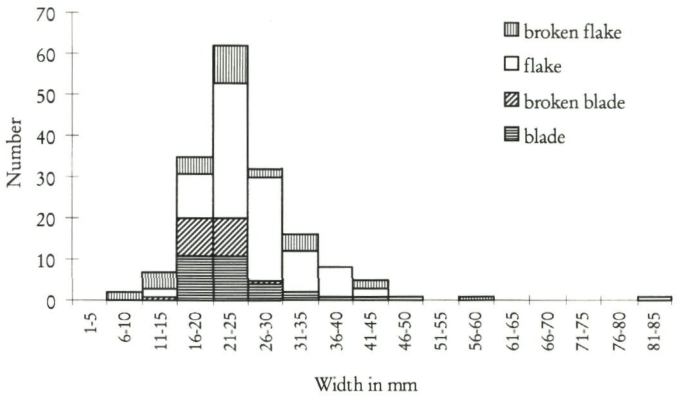
62 *Rekem 1984-86. Length of various scraper groups.*



63 *Rekem 1984-86. Width of scrapers (N=170).*



64 *Rekem 1984-86. Width of scrapers by category (N=170).*



The various scraper types turned up at various locations. There is no evidence of association between the principal scraper classes (on blade or on flake) and the major assemblages (with more than 10 scrapers). The χ^2 value for both classes and the assemblages of Rekem 1, 5, 6, 12, and 16 is 3.34, which is far less than the critical value (p=0.05) of 9.49 for 4 d.f.

5.4.1.2 Dimensions

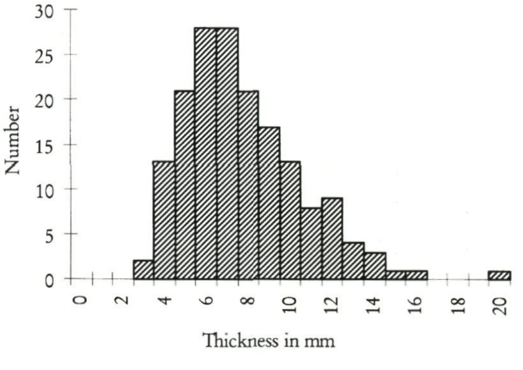
When all scrapers are taken together, lengths range from 7 to 99mm, with a mean of 34 ± 14 mm. The histogram, however, shows an asymmetrical, positively skewed distribution (fig. 61), with two outliers of more than 90mm. The mode is 26mm, the median 30mm. Actually, more than half of the scrapers (N=89) have a length between 22 and 35mm. Another third (N=57) are longer than 35mm, with high frequencies at 43-45mm. Only 14% of the scrapers (N=24), almost exclusively broken items, are shorter than 22mm (fig. 62). The asymmetry is partly explained by the clear differences in length between flake and blade scrapers, as shown in the compound histogram fig. 62, with a mode of 17-21mm for broken flake scrapers, of 22-26mm for flake scrapers and broken blade scrapers, and of 42-46mm for complete blades.

The histogram of scraper widths shows a more regular distribution (fig. 63). Except for the two extremely large scrapers (59 and 83mm wide), widths range between 8 and 46mm, with a mean for the total sample of 25 ± 9mm, and a very similar mode (24mm) and median (25mm). The compound histogram (fig. 64) shows that width distributions and averages are analogous for flakes and blades.

The scatter diagram of fig. 67 summarises the length-width relation of the various scraper classes. A well-defined boundary can be observed for the complete simple scrapers just above 20mm of length. As stated above, shorter scrapers are almost exclusively broken elements.

Mean scraper thickness of the total sample is 7.8 ± 2.8mm, with a range between 3 and 20mm (fig. 65). Broken scrapers are on average somewhat thinner (6.6 ± 2.9mm) than unbroken specimens (8.2 ± 2.7mm).

65 *Rekem 1984-86. Thickness of scrapers (N=170).*



5.4.1.3 General morphology

A majority of the blade scrapers (29 of 50) are made on regular blanks with parallel edges and ridges. They have towards the scraper-head either triangular (14), trapezoidal (12), or multi-facetted (3) cross-sections (Table 88). The other specimens are end-scrapers on cortical blades (more than one third of the dorsal surface covered with cortex; N=12), generally with triangular or trapezoidal cross-sections; end-scrapers on crested blades (N=6), mostly with a triangular cross-section; or end-scrapers on 'irregular' blades (N=3).

About half of the 120 flake scrapers are made on regular blanks with parallel edges and with again one (N=21), two (N=26), or more ridges (N=8). Flake scrapers with a cortical dorsal surface are quite

Table 88
Rekem 1984-86. Blank types selected for scraper manufacturing.

	Blank type											
	Blade scrapers					Flake scrapers						
Cross-section	Cortical piece	Trimming piece	Parallel edges/ridges	Irregular blank	Total	Cortical piece	Trimming piece	Parallel edges/ridges	Irregular blank	Total	Total	%
Not observed	-	-	-	-	0	1	-	2	2	5	5	3%
Triangular	6	4	14	1	25	3	2	21	4	30	55	32%
Trapezoidal	5	1	12	-	18	1	-	26	-	27	45	26%
Multifacetted	-	1	3	1	5	2	-	8	7	17	22	13%
Irregular	1	-	-	1	2	24	-	2	15	41	43	25%
Total	12	6	29	3	50	31	2	59	28	120	170	100%
%	24%	12%	58%	6%	100%	26%	2%	49%	23%	100%		

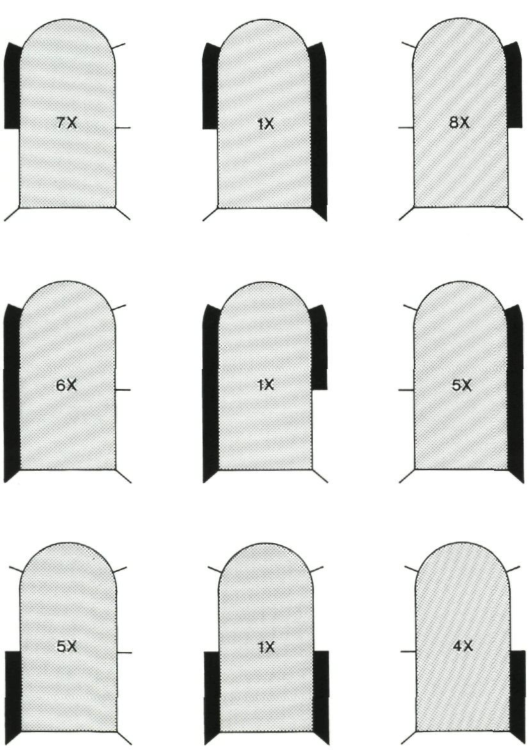
numerous (N=31). Trimming flakes seem to have been rarely transformed into end-scrapers (N=2). Obviously, that is because we often fail to recognise this type of blank in these heavily modified tools. Refitting showed that the technological category 'trimming flake' was indeed repeatedly selected. Finally, many flake scrapers are made on irregular blanks (N=28).

The lateral edges of the scrapers are mostly unmodified. Not a single scraper is retouched along its

Table 89
Rekem 1984-86. Scrapers. Type and origin of lateral modifications.

Type of (partial) lateral modification	Origin of modification: Obverse	Inverse	Alternating	Bifacial	Total
Semi-abrupt retouch	6	1	2	1	10
Marginal retouch	4	6	1	-	11
Flattened retouch	2	-	-	-	2
Splinters/scars	8	4	2	1	15
Total	20	11	5	2	38

66 *Rekem 1984-86. Locations of lateral modifications on scrapers.*



67 *Rekem 1984-86. Length-width measurements of scrapers.*

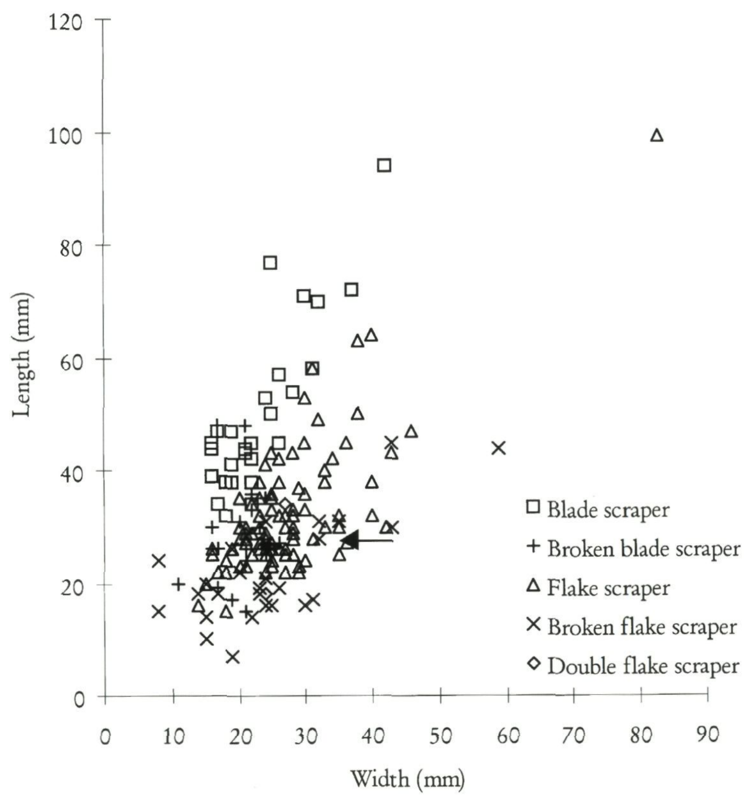


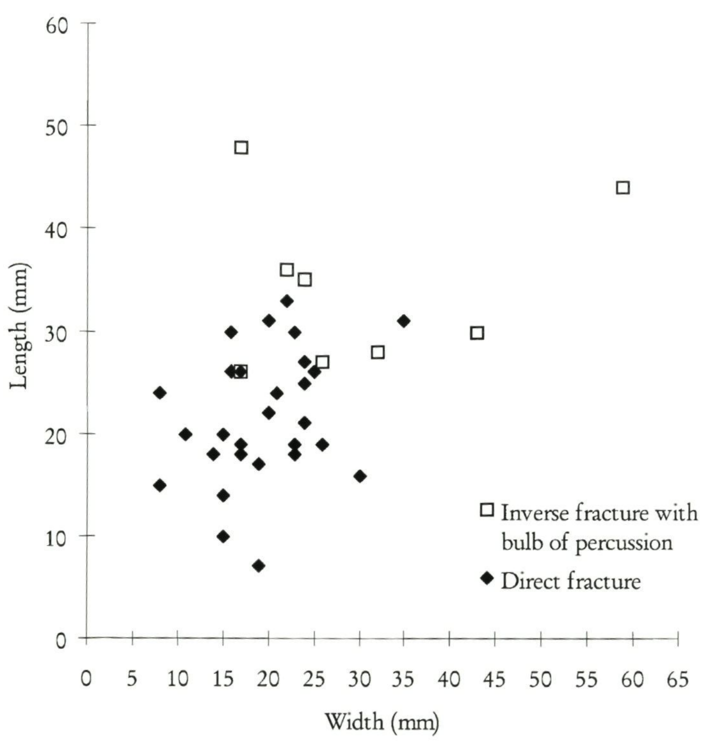
Table 90
Rekem 1984-86. Scrapers. Type and origin of fractures and refits of broken items.

Fracture-type	Fracture-origin Indet.	Direct	Inverse	Lateral	Thermic	Total	Refitted breaks
Snap terminating bending fracture	2	22	1	1	-	26	5
Snap fracture with visible bulb of percussion	-	-	8	-	-	8	-
Feather terminating bending fracture	-	2	-	-	-	2	1
Hinge terminating bending fracture	-	4	-	-	-	4	2
Thermic fracture	-	-	-	-	8	8	-
Total	2	28	9	1	8	48	8

entire edge; only two blade scrapers are retouched on more than one third of the length of their lateral edges (Pl. 96: 6, Pl. 97: 18). Moreover, the lateral modification that is found on a total of 22% of the scraper blanks (14 blades and 24 flakes), is not very standardised (Table 89). None of it significantly altered the original shape of the edge. Most modifications tend to be splinters or scars, discontinuously distributed and with no systematic localisation (fig. 66). The latter is also valid for the (intentional) retouches that are often very marginal, or at most semi-abrupt. All these modifications can be obverse as well as inverse, or alternating. The possible relationship of these modifications to functional aspects (hafting) is discussed below.

[144] A few fractures can possibly be ascribed to trampling or to other post-depositional agents.
[145] Rigaud 1977.
[146] Rigaud 1977, 22.

68 *Rekem 1984-86. Dimensions of broken scrapers by origin of fracture.*



Another issue to which we shall return in the discussion on hafting is the presence of broken scrapers (N=48, or 28%). Several arguments can be offered to suggest that breaks mostly occurred after the manufacture of the scraper-head. They seem to have occurred during the use of the scraper or while the tool was being resharpened[144]. In the first place, broken specimens are considerably shorter than the complete counterparts (fig. 67), which would be unlikely if the artisan had started scraper manufacture with broken blanks. The most solid argument, however, is provided by the analysis of the fracture types and their origin (Table 90). It appears that while some feather (N=2) and hinge (N=4) terminating fractures occur, most of the non-thermal breaks are snap fractures without (26) or with (8) a bulb of percussion. The latter originated from coercion applied on the dorsal surface of the blank and can be regarded as representing intentionally broken blanks, possibly broken to remove the thick proximal part (bulb of percussion) for hafting purposes (*e.g.* Pl. 91: 3, Pl. 96: 1,5,10). The other types, however, were clearly direct fractures, originating from coercion on the ventral face, and almost certainly occurred as a result of use or resharpening. One refitted item even combines an (intentional) inverse fracture on the proximal end with an (accidental) direct fracture in its central part (Pl. 92: 12). The lengths of the broken scrapers also clearly vary depending on the origin of the fracture (fig. 68): scrapers with an inverse fracture range from 25mm to almost 50mm, whereas scrapers with direct fractures are systematically shorter than 35mm. Moreover, this pattern perfectly matches observations from the extensive experimental work by A. Rigaud[145], who found that 93% of the breaks occurring during resharpening, and 90% of the breaks that happened during usage of hafted tools, produced an end-scraper of less than 35mm in length[146]. He actually proposed 35mm as an arbitrary length above which end-scrapers were classified as having been made on broken blanks.

A large majority of the scraper-heads on both flakes and blades are placed at the distal end of the blank (N=160; 93%). Only 12 scrapers, including the 2 double end-scrapers, are proximally retouched. In those cases where the distal end of the blank has been left unmodified, this appears to be quite irregular (*e.g.* Pl. 91: 6,14), or to have suffered from hinging (Pl. 98: 2). In general, the distal position of the scraping edge was obviously favoured for the sharp angle between ventral and dorsal face at this position, and was possibly also chosen for the slight distal curvature on many blanks (see below). Placing a scraping edge on the proximal end of a blank is more difficult because of the pronounced bulbs of percussion and the 'thick' buts on most of the Rekem blanks resulting from the stone hammer percussion.

A majority of the scraper-heads (N=101; 59%) are symmetrical relative to the flaking axis in the sense that a line connecting the corners of the scraping edge forms an angle of approximately 90° with the working axis of the blank (Table 91). Asymmetrical scraper-heads occur slightly more frequently on flakes (39%) than on blades (28%). There is, on the other hand, no evidence of association between symmetric versus asymmetric scraper-heads and the specific loci at Rekem. The χ^2 value for symmetric versus asymmetric scraper-heads and the assemblages of Rekem 5, 6, and all other assemblages together[147] is 3.01, which is less than the critical value (p=0.05) of 5.99 for 2 d.f.

A closer look, however, reveals that asymmetrical scraper-heads more frequently deviate to the right (N=38) than to the left (N=23). In both cases, the small angle of the orientation relative to the flaking axis generally measures between 75° and 85° (Table 92). More surprisingly, it appears that the left-oriented scraper-heads are exclusively present at Rekem 6, where they are predominant, and at Rekem 5 (Table 93). The χ^2 value for left versus right orientation and the assemblages of Rekem 5, 6, and all other sites together is 14.03, which allows the null hypothesis of independence to be rejected at the 0.2% level. At Rekem, in other words, there is a significant association between left or right asymmetry of the scraper-heads and different loci.

Table 91
Rekem 1984-86. Scrapers. Position and orientation of scraperheads on the blanks.

Scraperhead position	Scraperhead orientation: Not observable	Symmetric	Asymmetric to the left	Asymmetric to the right	Total	%
Blade scraper						
Proximal	-	3	-	1	4	2%
Distal	-	33	6	7	46	27%
Total	*0*	*36*	*6*	*8*	*50*	*29%*
Flake scraper						
Proximal	-	5	2	1	8	5%
Distal	10	60	15	29	114	66%
Total	*10*	*65*	*17*	*30*	*122*	*71%*
Grand total	10	101	23	38	172	100%
%	6%	59%	13%	22%	100%	

Table 92
Rekem 1984-86. Scrapers with asymmetrical scraperheads. Angle of orientation of scraperheads relative to the flaking axis.

Scraperhead angle of orientation	Scraperhead orientation: Asymmetric to the left	Asymmetric to the right	Total
35°-45°	-	1	1
45°-55°	-	3	3
55°-65°	4	1	5
65°-75°	5	12	17
75°-85°	14	21	35
Total	23	38	61

5.4.1.4 Scraping edge morphology

The majority of the scraping edges have a regular convex shape (N=101, 59%), mostly with a non- or semi-convergent retouch pattern (Table 94). About one quarter (N=42) of the scraper-heads are convex but flattened, while straight scraper-heads (N=7) on the one hand, and ogival (N=7) or nosed (N=6) scraper-heads on the other hand, occur less frequently. Finally, a few scrapers have sinuous (N=6) or irregular (N=3) scraping edges.

Seemingly, the cross-sections of the blanks partly co-determined the retouch patterns of the scraping edges (Table 95). Most of the convergent scraper-heads are situated on blanks with a triangular cross-section, where the removal scars generally converge on the central ridge (cf. Pl. 91: 13, Pl. 92: 4,5, Pl. 93: 2, Pl. 96: 5,7,17, Pl. 97: 22). This does not mean that scraping edges on triangular blanks are predominantly convergent. On the contrary, like on all other types of cross-sections, non-convergent and semi-convergent retouch patterns still dominate. On blanks with an irregular cross-section, even 88% (38 of 43) of the determined scraping edges are non-convergent. Secondly, retouch patterns on the scraper-head are also co-varying with scraper-head thickness (not with blank thickness!). Convergent retouch patterns tend to occur on thicker scraper-heads (mean = 8mm) than do semi-convergent (mean scraper-

Table 93
Rekem 1984-86. Orientation of scraperheads at the various loci.

Scraperhead orientation	Locus: 1	2	4	5	6	7	8	10	11	12	14	16	Total
Not observable	-	-	-	4	3	-	-	-	-	2	-	1	10
Symmetric	7	1	1	30	23	5	3	5	3	12	5	6	101
Asymmetric to the right	3	1	-	13	4	-	-	1	4	6	1	5	38
Asymmetric to the left	-	-	-	12	11	-	-	-	-	-	-	-	23
Total	10	2	1	59	41	5	3	6	7	20	6	12	172

[147] In order to avoid expected frequencies to be less than 5, values of the other sites had to be combined.

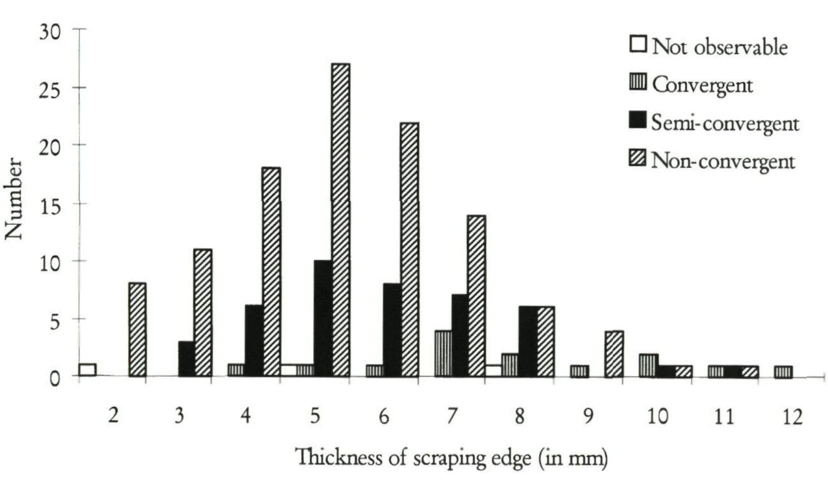
Table 94
Rekem 1984-86. Crosstable of outline and retouch convergence of scraperheads.

Scraperhead Outline	Scraperhead - Retouch pattern Not observable	Convergent	Semi-convergent	Parallel	Total	%
Convex - Ogival	-	-	1	6	7	4%
Convex - Regular	3	12	32	54	101	59%
Convex - Flattened	-	2	8	32	42	24%
Straight	-	-	-	7	7	4%
Sinuous	-	-	-	6	6	3%
Nosed	-	-	1	5	6	3%
Irregular	-	-	-	3	3	2%
Total	3	14	42	113	172	100%
%	2%	8%	24%	66%	100%	

Table 95
Rekem 1984-86. Crosstable of retouch convergence of scraperheads and cross-section of blanks.

Blank Cross-section	Scraperhead - Retouch pattern Not observable	Convergent	Semi-convergent	Non-convergent	Total
Not observable	1	-	-	4	5
Triangular	-	11	17	28	56
Trapezoidal	-	1	15	29	45
Multi-facetted	1	1	6	14	22
Irregular	1	1	4	38	44
Total	3	14	42	113	172

head thickness = 6mm) or non-convergent (mean scraper-head thickness = 5mm) patterns (fig. 69). When the latter are made on thick blanks, a substantial difference (max. 14mm) between blank thickness and scraping edge thickness is obtainable. For end-scrapers with convergent scraper-heads, this difference is always small (max. 3mm).



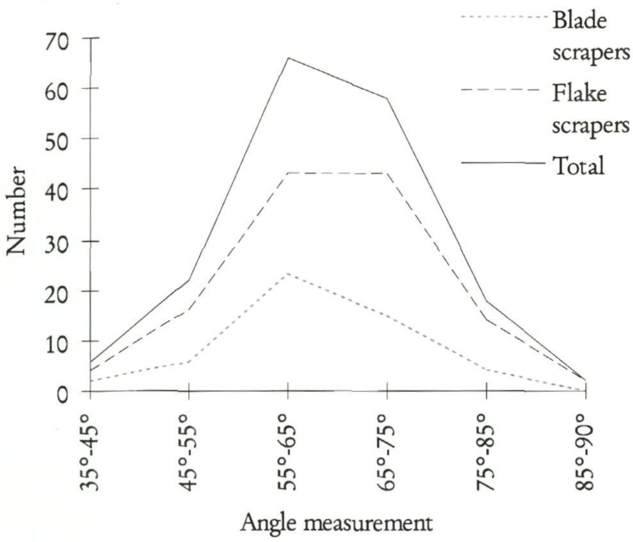
69 *Rekem 1984-86. Thickness of scraping edges with various retouch patterns.*

While true denticulated fronts occasionally occur (*e.g.* Pl. 91: 12, Pl. 93: 11), retouch outlines on the scraper fronts are generally quite regular. However, on closer inspection, a distinction could be made between 'regularised' scraper fronts with a 'smooth', plain edge and others with fine indentations on the edge as a result of retouching. That is, tiny spurs normally occur on the scraping edge cut on the spots where the ridges between two retouch scars on the scraper front meet the ventral face of the blank. On the 'regularised' scraper fronts, these spurs seem to be removed by refined 'secondary' retouch[148] that must have produced mini-chips (flint dust). The assumption that this regularisation served a functional purpose, such as to prevent the scraper front from scratching the hide, can be sustained by the microwear results (section 5.4.2.1).

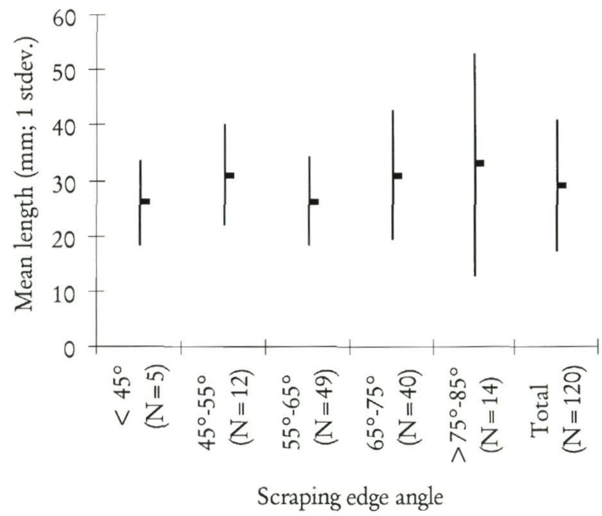
Distal ends of the scraper retouch negatives are mostly regular (Pl. 115: 1). That is, they smoothly meet in an oblique angle with the dorsal surface of the blank. One quarter of the scraper fronts (43/172), however, partially display hinging removals that have created a kind of overhang on the front. This overhang mostly appears at less than 1mm from the proximal end of the removals (N=28) and in those cases does not seem to drastically alter the general appearance of the scraper-head. In fact, it often seems to be associated with the removal of the tiny spurs mentioned earlier[149]. On other occasions, how-

[148] Technically, these spurs can also be eliminated by simple abrasion or by pressure of the front on an anvil, but these procedures inevitably dull the scraping edge cut an seem therefore inopportune.
[149] For experimental comparisons, see Rigaud 1977, 17.

70 *Rekem 1984-86. Scraping edge angles of flake and blade scrapers.*



71 *Rekem 1984-86. Complete simple scrapers. Mean length of scrapers by groups of scraping edge angles.*



ever, the overhang emerges further away from the edge and can be somewhat pronounced (N=15; Pl. 115: 2), sometimes corresponding with an irregularity in the flint material or with cortex (*e.g.* Pl. 91: 11, Pl. 96: 14). Scraper-heads got severely out of shape in these cases and generally acquired obtuse angles (*e.g.* Pl. 92: 12, Pl. 94: 14, Pl. 95: 9). Occasionally, repeated attempts at retouching also created partially crushed scraping edges (N=4; Pl. 96: 11, Pl. 115: 4).

Other 'irregularities' observed on the scraper fronts include partial fractures in the scraping edge, generally associated with 'weak' flint areas (N=2; Pl. 91: 8, Pl. 94: 9), small concavities or notches in the scraping edge outline (N=15; *e.g.* Pl. 95: 2, Pl. 97: 4,13) or conversely a protruding part (gibbosity) that apparently resisted removal (N=4; *e.g.* Pl. 92: 1, Pl. 93: 13, Pl. 95: 9, Pl. 115: 3). Some of these tooling mishaps probably prevented further rejuvenation.

The angles measured between the retouched surface of the scraping edge and the ventral surface of the blank, at the midpoint of the scraping front[150], varies between 40° and 90°. Most scraper-heads (72%), however, have medium scraping edge angles, measuring between 55° and 75°. Flake and blade scrapers have a comparable angle distribution (fig. 70). There is also no significant correlation between the angle of the scraping edge and the length of the scraper (fig. 71).

In spite of repeated claims in the literature that scraping edge convexity normally decreases as scrapers are resharpened[151], no such evidence could be detected at Rekem: there is no significant difference in the mean length of scrapers with scraping edge outlines ranging from convex-ogival to straight (fig. 72). Somewhat to the contrary, there is a remarkable difference in the extent of the scraping edges on blade scrapers on the one hand and on flake scrapers on the other. This is remarkable in view of the fact that the widths of both types of blanks are similar (see above). The length of the mean scraping edge (measured as the total length of the scraping edge curve) as well as the width of the mean scraping edge (measured as a straight line between the scraping edge corners) are both, on average, somewhat shorter on blade scrapers (22.6 ± 6.6mm and 19.2 ± 5.6mm respectively) than on flake scrapers (29.7 ± 14.0mm and 23.8 ± 8.9mm). Partly, these differences may be

[150] Because of the problematic accuracy of this measurement, due to the conchoid nature of flint fracture, we registered this angle in classes of 10°.

[151] *e.g.* Morrow 1997, 77.

72 *Rekem 1984-86. Complete simple scrapers. Mean length of scrapers by outline of scraping edges.*

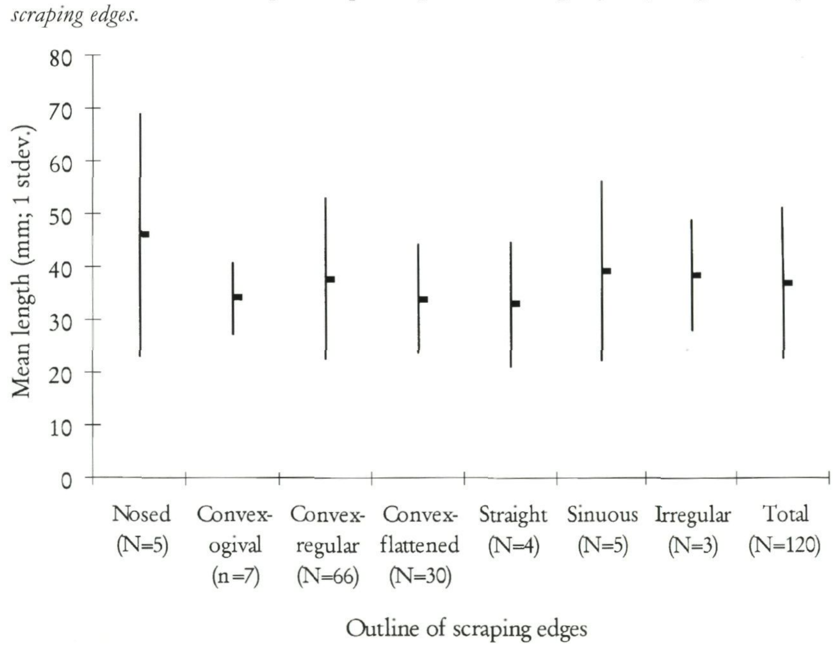


Table 96
Rekem 1984-86. Use frequency of scrapers and number of Intentional Use Zones (I.U.Z.).
* use percentage is calculated on the number of pieces suited for microwear analysis (MW) i.e. unaltered elements or pieces with limited alteration that can still be diagnosed.

Scraper type	Total number	N altered pieces	N suited for MW	N used pieces	% used *	N of I.U.Z./piece 1	2	4	Total N of I.U.Z.	Mean N of I.U.Z./piece
Simple endscraper	168	54	142	95	67%	88	6	1	104	1.09
Double endscraper	2	2	2	1	50%	0	1	0	2	2.00
Total	170	56	144	96	67%	88	7	1	106	1.10

accounted on the fact that asymmetrical scraper-heads occur slightly more often on flakes than on blades (see above). As the width of asymmetric scraping edges can exceed the blank width, their mean values of length (30.1 ± 13.4mm) and width (24.4 ± 8.8mm) become on average slightly greater than the length and width of the symmetric scraping edges (26.2 ± 9.9mm and 21.4 ± 6.9 respectively). On the other hand, the tendency for scraper-heads to be somewhat larger on flakes than on blades, may also be explained as a result of the fact that the former were perhaps more intensely retouched than the latter. In this light, there is also a slight difference in the mean scraping edge length of 'long' blade scrapers (23.5 ± 7.9mm) and their shorter variants (25.3 ± 6.6 mm) which may also have received more retouch. The mean scraping edge length of the broken (early discarded?) blade scrapers measures only 20.4 ± 4.5mm. All this seems to indicate that shorter scrapers at the time of abandonment were more intensely retouched than the longer specimens. However, before hazarding to conclusions on use-life patterns, we should first consider the results of the use-wear analysis.

5.4.2 The use of scrapers

5.4.2.1 Worked substances and actions

Examination of the microwear traces on the scrapers provided the following results.

One third of the pieces (56/170, or 33%; Table 96) showed traces of mechanical (N=36) or thermal (N=20) alteration to varying degrees. However, 30 of these altered pieces still allowed for a functional analysis, setting the total number of functionally interpretable tools to 144 (85%).

Two thirds of these scrapers (96/144, or 67%; Table 96) carry micro-use-wear, generally presenting one independent use zone (I.U.Z.). Seven implements, including a double scraper, had 2 I.U.Z., a single item presented 4 I.U.Z. (Pl. 92: 5). Together, 106 I.U.Z. have been counted, representing an average of 1.1 I.U.Z. per item.

The 'active' part of the scrapers was obviously the scraper-head, which carried 87% of all I.U.Z. (Table 97), and even 93% in case of the scrapers on flakes. The scraping edge was exclusively used in transverse actions (scraping). Other areas on these tools, including 9 unmodified and 4 damaged lateral edges, and once a dorsal ridge, had been occasionally engaged in transverse (7 I.U.Z.; *e.g.* Pl. 92: 5, Pl. 93: 15, Pl. 96: 4, Pl. 97: 23), as well as in longitudinal actions (7 I.U.Z.; *e.g.* Pl. 94: 19, Pl. 97: 1,8, Pl. 98:

Table 97
Rekem 1984-86. Scrapers. Action and worked substance of various Intentional Use Zones (I.U.Z.) observed on the scraperheads or on other areas of the tool.

Working area	Action	Contact Material: Wood	Fresh/ wet hide	Dry hide	Supple hide	Indet. hide	Bone/ antler	Carcass	Total I.U.Z.	% of I.U.Z.
Scraperhead	Transverse	5	18	62	-	3	4	-	92	87%
	%	5%	20%	67%	0%	3%	4%	0%	100%	
Other	Transverse	-	-	1	6	-	-	-	7	7%
	Longitudinal	1	-	2	-	-	2	2	7	7%
Total		6	18	65	6	3	6	2	106	100%
%		6%	17%	61%	6%	3%	6%	2%	100%	

Table 98

Rekem 1984-86. Scrapers. Crosstable of scraperhead use and scraping edge angle.
* calculation of use percentage is based on number suited for microwear analysis (MW).

Sraperhead Angle	Total number	Number suited for MW	Scraped substance: Wood	Fresh/ wet hide	Dry hide	Indet. hide	Bone/ antler	Total used	% used*
< 45°	6	6	-	-	1	-	-	1	17%
45°-55°	22	17	2	-	7	1	1	11	65%
55°-65°	66	54	1	8	24	1	2	36	67%
65°-75°	58	51	1	8	20	-	1	30	59%
75°-85°	18	17	1	2	9	1	-	13	76%
> 85°	2	1	-	-	1	-	-	1	100%
Total	172	146	5	18	62	3	4	92	63%

1,11). These use-traces are mostly found on blade scrapers and at times seem to have been generated independently from the use-wear found on the scraper-heads (*e.g.* in case of the supple (dry) hide traces, Pl. 92: 5, Pl. 93: 15, Pl. 96: 4).

90% of the scraper-heads were used to scrape hide (Table 97) which had been predominantly in a dry state (N=62; Pl. 114: 1-6). Less frequently, evidence for fresh/wet (N=18; Pl. 113: 5,6) or indeterminate (N=3) hide was also recorded. In exceptional cases, some possible wood working (N=5) and the scraping of bone or antler (N=4) could also be observed on these working edges. It should be noted that 5 of the dry hide scraping edges actually served on a hide in an intermediate state between fresh/wet and dry (see section 6.3.6.1.1).

No correlation could be detected between these contact materials on the one hand and, on the other, scraping edge angles (Table 98), scraping edge thickness (Table 99), orientation of the scraper-heads on the blanks (Table 100), or the type of blank supporting the scraper-heads (Table 101). With regard to use-rates, again no significant variation emerged in relation with these variables[152]. In fact, it seems that a wide range of scraper 'styles' was considered appropriate for use. Sometimes, the particularly opportunistic ap-

Table 99

Rekem 1984-86. Scrapers. Crosstable of scraperhead use and scraperhead thickness.
* calculation of use percentage is based on number suited for microwear analysis (MW).

Scraperhead thickness	Total number	Number suited for MW	Scraped substance: Wood	Fresh/ wet hide	Dry hide	Indet. hide	Bone/ antler	Total used	% used*
2-4 mm	48	39	3	3	16	2	-	24	62%
5-7 mm	95	82	2	8	38	1	4	53	65%
8-12 mm	29	25	-	7	8	-	-	15	60%
Total	172	146	5	18	62	3	4	92	63%

Table 100

Rekem 1984-86. Scrapers. Crosstable of scraperhead use and orientation of the scraperhead on the blank.
* calculation of use percentage is based on number suited for microwear analysis (MW).

Orientation of scraperhead on the blank	Total number	Number suited for MW	Scraped substance: Wood	Fresh/ wet hide	Dry hide	Indet. hide	Bone/ antler	Total used	% used*
Not observable	10	5	-	-	1	-	-	1	20%
Symmetric	101	88	4	10	39	2	3	58	66%
Asymmetric to the right	38	33	-	5	12	1	-	18	55%
Asymmetric to the left	23	20	1	3	10	-	1	15	75%
Total	172	146	5	18	62	3	4	92	63%

[152] The fact that left-oriented asymmetric scraper-heads are used relatively more frequently (75%) than right oriented scraper-heads (55%, Table 100) may obviously be ascribed to the fact that the former exclusively occur at the concentrations of Rekem 5 and 6, which in general have high use-frequencies (compare Table 93 with Table 169).

Table 101
Rekem 1984-86. Scrapers. Crosstable of scraperhead use and blank type of the scrapers.
* calculation of use percentage is based on number suited for microwear analysis (MW).

Blank type supporting the scraperhead	Total number	Number suited for MW	Scraped substance: Wood	Fresh/ wet hide	Dry hide	Indet. hide	Bone/ antler	Total used	% used*
Blade	50	45	2	4	21	-	2	29	64%
Flake	122	101	3	14	41	3	2	63	62%
Total	172	146	5	18	62	3	4	92	63%

plication of hardly modified 'naturally convenient' scraping edges could be observed (*e.g.* Pl. 91: 7,11, Pl. 93: 12). Finally, in the case of scrapers used on hide, there was no significant distinction regarding the scraper-head width between scraper-heads used on fresh/wet hide (mean width of 25 ± 6mm) or dry hide (23 ± 8mm).

However, when the relative number of use-wear traces are compared in relation to scraper-head outlines and retouch patterns, a different pattern emerges. There appears to have been a weak tendency for pronouncedly convex (ogival) scraping edges and scraper-heads with convergent retouch patterns to have been used more frequently than more flattened edges and scraper-heads with non-convergent (parallel) retouch (Table 102 and Table 103). The former were, apparently, better suited for hide working, possibly because a smooth transition from scraping edge to lateral edges on pronounced (ogival-) convex and convergent scrapers implicated less risk of damaging (tearing) the hide with the corners of the scraper-heads. On the other hand, the typological boundary between scrapers with a 'straight' scraping edge and truncated pieces is, of course, not always obvious (*e.g.* Pl. 94: 6, Pl. 97: 14, Pl. 98: 10) and it should be stressed that (parts of) sinuous, nosed, or irregularly outlined

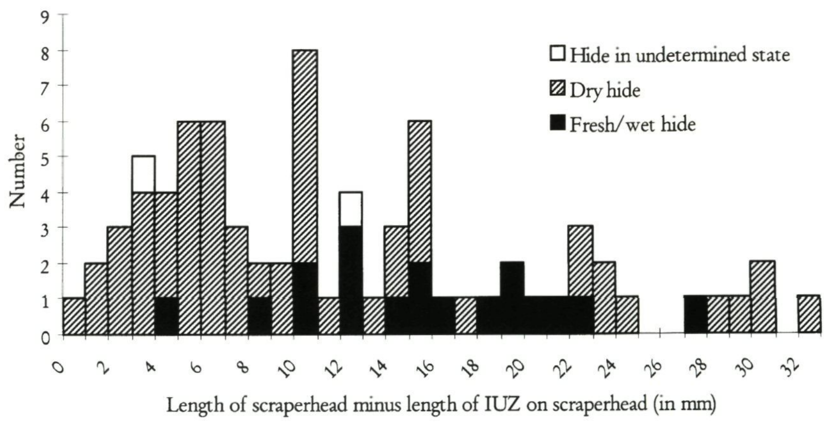
Table 102
Rekem 1984-86. Scrapers. Crosstable of scraperhead use and scraping edge outline.
* calculation of use percentage is based on number suited for microwear analysis (MW).

Scraperhead Outline	Total Number	N suited for MW	Scraped substance: Wood	Fresh/ wet hide	Dry hide	Indet. hide	Bone/ antler	Total used	% used*
Convex-Ogival	7	7	-	2	4	-	-	6	86%
Convex-Regular	101	85	4	10	42	1	4	61	72%
Convex-Flattened	42	34	1	6	8	2	-	17	50%
Straight	7	7	-	-	1	-	-	1	14%
Sinuous	6	6	-	-	3	-	-	3	50%
Nosed	6	4	-	-	2	-	-	2	50%
Irregular	3	3	-	-	2	-	-	2	67%
Grand Total	172	146	5	18	62	3	4	92	63%

Table 103
Rekem 1984-86. Scrapers. Crosstable of scraperhead use and scraperhead retouch pattern.
* calculation of use percentage is based on number suited for microwear analysis (MW).

Scraperhead Retouch pattern	Total Number	N suited for MW	Scraped substance: Wood	Fresh/ wet hide	Dry hide	Indet. hide	Bone/ antler	Total used	% used*
Convergent	14	13	-	3	7	-	1	11	85%
Semi-convergent	42	38	2	5	16	1	2	26	68%
Parallel	113	94	3	10	39	2	1	55	59%
Not observable	3	1	-	-	-	-	-	0	0%
Total	172	146	5	18	62	3	4	92	63%

73 *Length of the unpolished part on the scraping edges used on fresh/wet and dry hide.*



scraping edges seemed frequently and equally suitable (*e.g.* Pl. 91: 7,10, Pl. 93: 16,18,19).

Fig. 73 shows that traces (roundings) of dry hide scraping are inclined to cover the entire length of the scraping edge cuts whereas scraping edges used on fresh/wet hide tend to be affected only partly. On the other hand, dry hide traces are mostly centred on the scraping edge extent, while traces of fresh/wet hide scraping are in equivalent proportions either symmetrical, or inclined on the right side of the scraper-head (Table 104). In addition, 5 of the scraping edges with asymmetric dry hide traces on the right (N=4) or on the left side (N=1) actually served on a hide in an intermediate state between fresh/wet and dry. These differences in the position of the traces may be the result of several factors. Firstly, the position of the hides being worked (vertical, oblique, or horizontal). Secondly, the correlating position of the worker (on his/her knees, sitting, or standing straight up) and thirdly, the sort of haft being used (straight or bent) and the mode of prehension

It should be noted that the position of microwear traces does not necessarily correlate with the orientation of the scraper-heads on the blank, *i.e.* left-oriented scraper-heads can have use-wear on the right-hand side and vice-versa, whereas use-wear on symmetrical scraper-heads can also be situated left or right (Table 105). However, since almost half of the scrapers with use-wear on the right-hand side present a right-oriented scraper-head (9/21), it seems that occasionally the artisan anticipated the activity to be performed while manufacturing the scraper. Alternatively, used up parts of the scraping edge cut may have been emphasised during resharpening which would equally have lead to an asymmetrical orientation of the scraper-head.

With regard to the 'section of rounding', the asymmetric roundings outnumber the symmetric traces, a predominance essentially induced by the fresh/wet hide scrapers (Table 106).

One third of the scraping edges used on hide present microscopic ventral scars, quite often associated with fresh/wet hide work (Table 107).

For the totality of used scraping edges, a pertinent correlation could be found between use-rates and the presence of tiny spurs (indentations) on the scraping edge. Whereas 82% of the regularised, 'flush' edges (with a more or less plain edge course) manifested use-wear, microwear traces on scraping edges with small indentations appeared on only 13% of these items. So-called 'hybrid' scraping edges, with partially regularised scraping edge cuts, have a use rate of 62%. In those cases, however, the use-wear traces are often restricted to the regularised part and clearly anterior to final resharpening of the other part where indentations are 'preserved' (*e.g.* Pl. 92: 5,10, Pl. 115: 5,6).

This seems to support the assumption that the tiny spurs were generally removed by a secondary procedure just before the use of the scraper. If such use was deemed unsuccessful, for instance because resharpening had reduced the length of the scraper too much, the implement was discarded without further consideration. Indeed, it has been noted that complete simple scrapers with indentations on the scraping edge are almost systematically less than 30mm long and on average about 10mm shorter than their counterparts with regularised edges.

The presence of small overhangs on the scraper front (less than 1mm from the proximal end of the removals) does not seem to have impeded the utilisation of the scrapers. In 78% of cases, scrapers car-

Table 104

Rekem 1984-86. Scrapers. Position of usewear traces on scraping edges used on hide.

Location of IUZ on scraping edge	State of scraped hide Fresh/wet hide	Dry hide	Indet. hide	Total
Undetermined	-	6	1	7
Central	9	35	2	46
On the right-hand part	9	12	-	21
On the left-hand part	-	9	-	9
Total	18	62	3	83

Table 105

Rekem 1984-86. Scrapers. Position of usewear traces on scraping edges used on hide versus orientation of scraperheads on the blanks.

Orientation of scraperhead on the blank	Location of IUZ on the scraping edge Undetermined	Central	On the right-hand part	On the left-hand part	Total
Not observable	1	-	-	-	1
Symmetric	3	32	10	6	51
Asymmetric to the right	3	5	9	1	18
Asymmetric to the left	-	9	2	2	13
Total	7	46	21	9	83

Table 106
Rekem 1984-86. Scrapers. Section of rounding of usewear traces on scraping edges used on hide.

Section of rounding	State of scraped hide Fresh/wet hide	Dry hide	Indet. hide	Total
Asymmetric	12	30	3	45
Symmetric	6	32	-	38
Total	18	62	3	83

Table 107
Rekem 1984-86. Scrapers. Microscopic ventral scars on scraping edges used on hide.

Ventral scars on scraping edge	State of scraped hide Fresh/wet hide	Dry hide	Indet. Hide	Total
Absent	9	45	2	56
Present	9	17	1	27
Total	18	62	3	83

rying these 'irregularities' are used. As remarked earlier, these small overhangs are precisely associated with the removal of the tiny spurs and therefore are indeed a good indication that the item represented a 'finished' tool.

The more pronounced overhangs similarly did not obstruct the use of the scraper, at least when they were combined with regularised edges: 7 of 9 scraper-heads with this feature carry use-wear (Pl. 91: 11, Pl. 92: 11, Pl. 93: 19, Pl. 94: 1, Pl. 96: 14). On the other hand, it seems that these overhangs prevented successful rejuvenation, as can be shown by their recurrent combination with partially crushed scraping edges due to repeated modification attempts. Scrapers with such crushed edges were in fact never used (Pl. 94: 20, Pl. 96: 11-13).

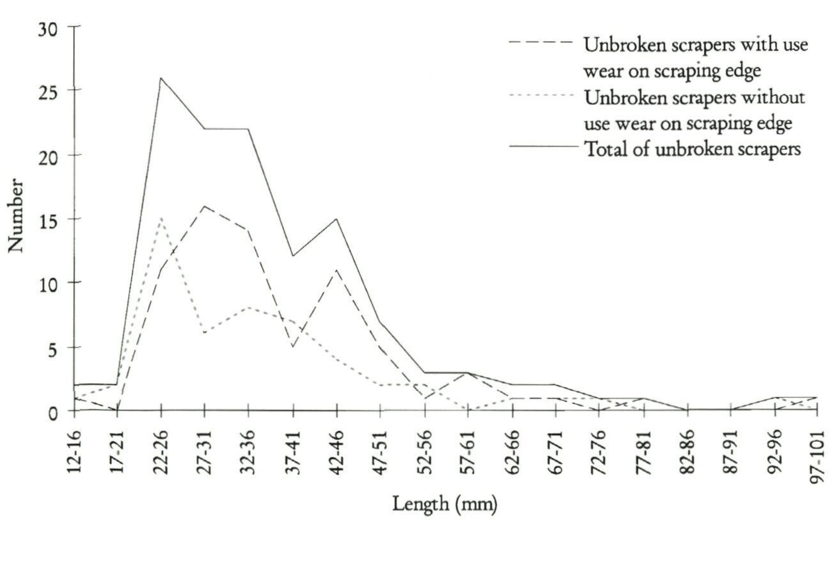
Other 'irregularities' on the scraper front that apparently hampered successful scraping, were small concavities or notches in the scraping edge outline. Less than one quarter of the scrapers with this peculiarity have traces of use, and again, these use-wear traces were mostly generated in a previous stage of the scraper's use-life (*i.e.* before the concavity appeared; Pl. 93: 15, Pl. 97: 4,12). For the scrapers with a protruding part in the scraping edge outline, the evidence is very restricted; one of the two scrapers with a gibbosity that was suited for microwear analysis carried use-wear which had again been generated before resharpening (Pl. 93: 13).

Finally, it may be remarked that both the scrapers with partial fractures in the scraping edge cut had been used. In one case, the fracture occurred after use (Pl. 94: 9) while in the other the fracture corresponds with a fragile area of poor silicification that did not register any traces of use-wear (Pl. 91: 8).

In spite of ample attempts, no other immediate correlation between morphology and use could be observed in this tool class, except perhaps for a striking dimensional deviation of certain items used on wood (Pl. 95: 7, Pl. 98: 1). In general, however, no clear pattern could be detected when the occurrence of used scraper-heads was compared with the length of complete scrapers (fig. 74).

On the other hand, an unexpected correlation emerged between the type of substance worked by used scrapers and the type of flint employed in making the scraper. At Rekem 5, the only location with substantial evidence of fresh/wet hide working, it appeared that the 13 scrapers used on fresh/wet hide were made exclusively in coarse-grained flint. All of the (used) scrapers made of the fine-grained variant of 'Hesbaye type' (N=19) were involved in dry hide working. One might question whether this dichotomy reflects a conscious choice on the part of the artisan. Perhaps functionality (inappropriate grip of fine-grained flint on fresh/wet hides?) may be the reason for this dichotomy. Equally it may be the haphazard result of different individuals (or one individual at different moments in time) making two series of scrapers designed for separate tasks and fortuitously using different flint types. The refitting and spatial analysis suggested the latter factor to be at least co-responsible (section 6.3.6.1).

74 *Rekem 1984-86. Length of unbroken scrapers by presence of usewear on the scraping edge*



5.4.2.2 Hafting

7 scrapers (1 used on fresh/wet hide, 6 on dry hide) bear positive hafting traces on the prominent parts (bulbs of percussion, dorsal ridges) and/or on one or both lateral edges of the blanks (Pl. 91: 13,14, Pl. 93: 2,6, Pl. 94: 17). Furthermore, 1 blank frag-

ment, which can be refitted to a broken scraper, also bears hafting traces (Pl. 92: 10). The fact that the latter traces occur on both fragments of the broken item – which had presumably snapped during resharpening – suggests that the scraper gradually moved in its haft in the course of its use-life, much as can happen in a modern retractable paper-cutter.

Generally speaking, the hafting polish is poorly developed and does not exceed the stage of a 'generic weak polish' as described by Vaughan[153]. This naturally impedes the recognition of the exact nature of the haft substance(s) or of possible ligatures. However, the possibility remains that the limited frequency of such traces at Rekem may be ascribed to a less profound investigation of the unmodified edges and faces of the scrapers. An exhaustive examination combined with an experimental hafting program might increase the frequency of the observations of these traces on the archaeological assemblage.

Other features of a macroscopic nature suggest that scrapers were indeed used in a haft.

Firstly, the occasional presence of scars on the lateral edges (Table 89; fig. 66) might result from friction against the haft or its ligatures.

Secondly, as opposed to the burins (min. 30mm), the scrapers at Rekem have a minimum length of 22mm, which is probably too short to allow effective hand-held use. In fact, this agrees with the experimental data[154].

Thirdly, the intentional removal of the (thick) proximal part of some scraper blanks might be to assist hafting (Pl. 91: 3, Pl. 96: 1,5,10).

Fourthly, as discussed above (section 4.1.3 of this chapter), direct fractures close to the active scraping edge, most likely result from the accidental breakage of hafted specimens. Moreover, it is interesting to note that fresh/wet hide scrapers (N=18) at Rekem are never broken. In other words, broken scrapers carrying use-wear on the scraper-head are exclusively associated with work on 'hard' materials (wood and bone/antler; 5 of 9 scrapers are broken) and on (stiff and brittle) dry hide (14 of 62 scrapers are broken; Table 108). If we only consider direct snap breakages (*i.e.* fractures that might represent accidents by use or resharpening) then the number of broken dry-hide scrapers is limited to 9. This number is amazingly identical to the results reported from the *Federmesser* site of Meer II, where also 9 out of 62 dry-hide scrapers show snap breakages[155]. At Meer, comparisons between broken and unbroken specimens led the author to the conclusion that "*breakages occurred during use*"[156]. Two aspects were considered meaningful in supporting this argument. First, the broken scrapers appeared to be significantly thinner than the unbroken specimens (respectively 5.1 ± 2.5mm and 9.1 ± 3mm) which would have been unlikely if the breakages had been intentional. Second, the broken scrapers showed less wear than the unbroken examples. Keeley suggested that this was related to the fact that breakages which occurred during use rendered the further use of the tool impossible or very difficult. At Meer, two thirds of the broken dry hide scrapers, and only 25% of the unbroken pieces showed 'light wear'. Again, almost identical results have been obtained at Rekem (Table 109). The average thickness of the broken (in direct snap fracture) and unbroken dry-hide scrapers was respectively 5.2 ± 1.6mm and 8.1 ± 2.2mm, while two thirds of the broken dry-hide scrapers and only 25% of unbroken elements were used for a short time (*i.e.* few to maximum ca. 20 minutes[157]). The

Table 108
Rekem 1984-86. Scrapers. Crosstable of contact material of scraping edges by origin of fracture on broken scrapers.

Fracture-origin	Contact material: Wood	Fresh/ wet hide	Dry hide	Indet. hide	Bone/ antler	Total
Indeterminable	-	-	1	-	-	1
Direct	3	-	9	1	2	15
Inverse	-	-	3	-	-	3
Thermic	-	-	1	-	-	1
Not broken	2	18	48	2	2	72
Total	5	18	62	3	4	92

Table 109
Rekem 1984-86. Scrapers. Mean thickness and use time of complete or broken dry hide scrapers by origin of fracture.

Fracture-origin	Number	Average Thickness (mm)	Std. Dev. of Thickness	Use time 2	3	4	% used 'shortly'
Indeterminable	1	6.00	0	-	1	-	0%
Direct	9	*5.22*	1.56	6	3	-	*67%*
Inverse	3	6.33	1.15	1	2	-	33%
Thermic	1	8.00	0	-	1	-	0%
Not broken	48	*8.06*	2.25	12	34	2	*25%*
Total	62	7.53	2.32	19	41	2	31%

153 Vaughan 1985a.
154 *e.g.* Morrow 1997, 78.
155 Unfortunately, the author (Keeley 1978, 78) did not specify whether these breakages originated from the dorsal or from the ventral face.
156 Keeley 1978, 78.
157 This calculation evidently only relates to the final stage of the scraper's use-life.

others had more prolonged use and some of the unbroken specimens had been used for more than one hour[158]. In all, the evidence at Rekem shows very similar results. If the arguments used at Meer are accepted, this would imply that at least some of the breakages on dry hide-scrapers at Rekem also occurred during use. When scraping hides, the working pressures generated using hand pressure alone are not great. Keeley has therefore suggested that "*these broken end-scrapers were hafted and that these hafts substantially increased the amount of leverage exerted on the blank to the point that an awkward movement during use could snap them*"[159]. It should be recalled, however, that blanks could also break during the modification of the scraping edge. In fact, some used scraper-heads at Rekem bear traces of the initial stages of resharpening (cf. Pl. 92: 10).

Finally, the use of a haft also indirectly affects the use-wear location. In fact, recent ethnographic observations[160] reveal that the position of the hands on the haft may affect the position of the microwear traces on the active scraping edge cut as follows.

a) When both hands are joined at the extremity of the haft next to the scraper and placed in an identical position, both the power and direction of the movement are symmetric and simultaneous thus generating fully symmetric traces on the active scraping edge cut.

b) Conversely, when the two hands are separated, the power and direction become asymmetric and are not simultaneous. This favours radiating traces on the active part of the scraping edge cut. The angle of use is dictated by whichever hand is closest to the hafted flint tool. In other words this is to the left when the left hand is close to the scraper and to the right in the opposite case.

At Rekem, the varying positions of the hide scraping traces on the scraping edges (see above) may thus reflect diverse kinds of working and/or different haft types.

In conclusion, functional evidence shows that the scrapers at Rekem were mostly hafted and almost exclusively served to scrape (mainly dry) hide. There are on average clearly less I.U.Z. per (used) item than on the burins. On the other hand, two thirds of the scrapers suitable for microwear analysis had traces of use, against only slightly more than half of the burins. These contrasts reflect different types of manipulation for the respective tool categories.

5.4.3 Dynamic approach: scraper use-lives

In this section, we will try to reconstruct how the *Federmesser* scrapers were made and 'consumed' (used/resharpened) and why they were eventually abandoned. Most information in this respect was again retrieved from refitting. Altogether, 31 scrapers (19%)[161] have been conjoined with at least one other artefact (Table 110). Most of them (25) are involved in sequential refitting, 2 equally, and 6 exclusively in break conjunctions. Because of the excessive amount of work involved in obtaining significant results, we have not yet systematically attempted to refit retouch flakes onto scraper fronts.

5.4.3.1 Scraper blank production: results of dorsal-ventral refitting and flint type analysis

The refitting of scrapers into production sequences provides in the first place an accurate means of reconstructing the original blanks selected for scraper manufacture. In 15 cases, the outline of the ventral face of the scraper was at least partly preserved on the 'surrounding' refitted artefacts, allowing us to reconstruct the part of the blank that had been removed by the retouch of the scraper-head

[158] These very intensely used items display rounded edges that are even visible and tangible macroscopically (*e.g.* Pl. 91: 11).
[159] Keeley 1978, 78.
[160] Beyries 1997.
[161] At first sight, this refit percentage seems very similar with the success rate at Niederbieber (16% if site I and IV are counted together; Bolus 1992). However, while at Rekem, scrapers are mainly refitted into reduction sequences and partly as broken tools, at Niederbieber they mainly concern burnt fragments and retouch flakes. As these categories unfold dissimilar information, comparisons are hardly possible.

Table 110
Rekem habitation zone 1. Scrapers. Refitting results by locus and by blank type.

	Locus												Blank type	
Refitting type	1	4	5	6	7	8	10	11	12	16	Total	% refitted	Blade	Flake
Reduction sequence	-	-	15	2	-	-	1	-	2	3	23	14%	9	14
Fracture	1	-	3	-	-	-	-	-	1	1	6	4%	6	-
Reduction+fracture	-	-	2	-	-	-	-	-	-	-	2	1%	1	1
Total refitted pieces	1	-	20	2	-	-	1	-	3	4	31	19%	16	15
Not refitted	9	1	38	39	5	3	5	7	16	8	131	81%	32	99
Grand Total	10	1	58	41	5	3	6	7	19	12	162	100%	48	114
% refitted	10%	0%	34%	5%	0%	0%	17%	0%	16%	33%	19%		33%	13%

(Pl. 99). These blanks provide a very diverse sample, ranging from small 100% cortical flakes (Pl. 99: 2), by crested blades (Pl. 99: 9) and core tablets (Pl. 99: 5) to nice regular blades, cortical (Pl. 99: 8,14) or not (Pl. 99: 7). The single common feature that seems to be of importance to these specimens is the fact that the distal end always ends in a rather acute angle. As opposed to the blanks that had been selected for burins, *supports* with hinging or plunging ends are probably unsuitable for the initial phases of scraper manufacture.

The debitage refits also provide some information on tooling as they allow us to measure the amount of material that disappeared as a result of the installation of the scraping edges and successive rejuvenations. On the complete reconstructions, the reduction of the length of the blanks ranged from 3 to 32mm per item, but was generally situated between 1 cm and 2 cm. Partial reconstructions measured reductions of more than 8mm (2X), 13mm, and 15mm (2X) (Pl. 99). It seems tempting on such a basis to estimate the number of intermittent use-phases between the 'first' scraper and the discarded implement. Experiments show that a skilled knapper on average consumes some 2mm of length with each rejuvenation[162]. If in other words scraper-heads were accurately refreshed, these tools may have had at least several phases of use. Taking into account the modal use-time recorded in the microwear analysis (20 to 60 minutes), one may therefore assume that the 'active' use-lives of scrapers lasted at least several hours.

Together, the rate of debitage refits for scrapers (15%) is ranked between the results for slender lateral modified laminar pieces on one hand (3%) and for burins on the other (25%). As a first approach, these results suggest that scrapers were more frequently removed from their spot of fabrication than were burins, but – notwithstanding their hafting – were clearly less mobile than projectile heads. If more intensely 'curated' than burins, they were nevertheless repeatedly abandoned in (or near) the area where they had been manufactured, used, and possibly resharpened (see chapter 6). This interpretation is further sustained by the numerous unrefitted scrapers of which the specific flint type matches with flint types of refitted (co-)sets and/or of unrefitted debitage waste material (Table 111, codes 2 and 3). Only 7 scrapers are shown to have been produced outside their locus of discard, either because of their aberrant flint type (N=6), or because they refit with material from a distant locus (Table 111; codes 6 and 7). Four of these specimens were found at the dwelling of Rekem 10 (Pl. 96: 4,8) and at the possible (but disturbed) habitation of Rekem 12 (Pl. 97: 07). As noted in the study of the burins, the particular nature of these loci may have stimulated the introduction of extra-local elements. The 3 other scrapers come from the neighbouring and strongly connected loci Rekem 5 (Pl. 93: 10 and Pl. 94: 3) and Rekem 6 (Pl. 94: 17) and are therefore rather 'sub-local'.

The serial production of scrapers can also be documented, but not to the same degree as for the burins. The physically refitted series include 3 (1X), and 2 (4X) scrapers only (Pl. 99), although on the basis of the appearance of the raw materials, larger series are quite conceivable. The serial production of scrapers is also reported from Hengistbury Head (3 scrapers in one complex[163]), and from Meer II where up to 9 scrapers could be conjoined in a single block and which had all been used to scrape dry hide[164].

On the other hand, the scrapers at Rekem are frequently associated with other types of tools in single conjoinments (Table 112). The functional analysis has shown not only that such diverse tools may

Table 111

Rekem habitation zone 1. Origin of scraper blanks as evidenced by dorsal-ventral refitting and by flint type analysis.

Legend for origin of blank:

1. Refitted in a local reduction sequence including debitage waste material.
2. Unrefitted, but debitage waste material of this specific flint type is refitting at the locus.
3. Unrefitted, but member of a specific flint type including non-refitting debitage waste material at the locus.
5. Unrefitted and member of an unspecified flint type.
54. Member of an unspecified flint type refitted in a dorsal-ventral refit lacking debitage (i.e. only with other tools).
6. Unrefitted member of a flint type lacking debitage waste material.
74. Refitted with tool of other locus.

	Locus											
Origin of blank	1	4	5	6	7	8	10	11	12	16	Total	%
1	-	-	17	1	-	-	-	-	2	3	23	14%
2	1	-	23	1	3	-	-	2	12	1	43	27%
3	-	-	-	2	-	-	-	-	-	-	2	1%
5	9	1	16	36	2	3	3	5	3	8	86	53%
54	-	-	-	-	-	-	1	-	-	-	1	1%
6	-	-	2	-	-	-	2	-	2	-	6	4%
74	-	-	-	1	-	-	-	-	-	-	1	1%
Total	10	1	58	41	5	3	6	7	19	12	162	100%

Table 112

Rekem habitation zone 1. Compilation of refit-sets in which several tools are conjoined, including at least one scraper.

	Type of tool					Tool
Refit-set	Scraper	Burin	Truncation	Borer/bec	Retouched	total
05c14	3	1	-	1	-	5
05c08	2	1	-	-	-	3
05c05	1	6	1	-	1	9
05c01	1	1	1	-	-	3
05s063	1	1	-	-	-	2
10s50	1	1	-	-	-	2
05s091	2	-	-	-	-	2
05s095	2	-	-	-	-	2
16s18	2	-	-	-	-	2
16s24	1	-	-	-	1	2
Total	16	11	2	1	2	32

162 *e.g.* Caspar & Cahen 1987, Caspar 1988, Morrow 1997.
163 Barton 1992.
164 Van Noten 1978.

Table 113
Rekem habitation zone 1. Scrapers with use wear on a scraping edge. Refitting results.

	Scraped substance					
Refitting type	Wood	Fresh hide	Dry hide	Indet. hide	Bone/ antler	Total
Reduction sequence	-	5	11	-	1	17
Fracture	-	-	3	-	-	3
Reduction+fracture	-	-	-	-	1	1
Total refitted pieces	0	5	14	0	2	21
Not refitted	5	12	45	3	2	67
Grand Total	5	17	59	3	4	88
% refitted in reduction sequence	0%	29%	19%	0%	50%	20%
% refitted in fracture	0%	0%	5%	0%	25%	5%

have been employed in a single task, but also that scrapers of the same composition rarely worked different materials (*e.g.* fresh/wet hide and dry hide; see chapter 6).

The success rates for the refitting efforts are also quite variable at the different units (Table 110). At Rekem 5 and 16, one third of the scrapers could be used in refitting while at some other units (*e.g.* at Rekem 7 and 11) not a single tool could be refitted. Generally speaking, however, close affinities of the raw materials with local debitage suggest that local production occurred more frequently than can be presently shown (Table 111, code 2). Nevertheless, it seems that the central open air hearth area of Rekem 5 in fact represents a location where (scraping) activities were sufficiently substantial and enduring to the extent that most of the tools spent their entire use-life at the same spot. We will of course return to this issue in the spatial analysis (section 6.3.6).

Another surprise is the fact that scrapers with use-wear preserved on the scraper-head could be refitted more easily into reduction sequences (18/88, *i.e.* 20%; Table 113) than could items without use-wear traces (7/74, *i.e.* 9%). At first sight, one would expect unused items to include several shaping mishaps and thus to have been more regularly abandoned at the area of production. The opposite pattern, observed here, might rather indicate that the 'unused items' comprise mostly scrapers that have been transported ('curated') and probably consumed to a significant degree but which were not used again after their final rejuvenation. Spatial analysis will show that these items were indeed frequently abandoned outside the presumed areas of principal activity.

The highest rate of scrapers refitting in reduction sequences was obtained for fresh/wet hide scrapers[165] (29%; Table 113). It seems that these items were clearly produced locally and remained at their place of use throughout their use-life. It should be stipulated, however, that fresh/wet hide scraping occurred almost exclusively at Rekem 5, where the activities also seem to have been the most substantial and enduring.

5.4.3.2 Refitting of broken scrapers

In all, 17% of the broken scrapers could be refitted with at least one other blank fragment. However, blade scrapers could definitely be refitted more easily in break refits than flake scrapers. Seven out of 20 broken blade scrapers and only 1 of 28 broken flake scrapers could be reconstructed to a more 'complete' tool. In the case of the blade scrapers, the completed tools are on average twice as long (54mm) as the broken parts (26mm). If we assume that this was the case for the entire population of broken blade scrapers, the mean length of the blade scrapers before breakage would have been more than 62mm. This is clearly more than the mean length of the unbroken blade scrapers (49mm) and seems to support the earlier suggestion that the latter were further resharpened. In other words, the fracture of at least some blade scrapers accidentally occurred during use or during resharpening (if of course, this difference is not just because longer specimens tend to break up more easily).

The close spatial relationships of most break refits (see below) also support our argument that scrapers were generally broken in use or manufacture rather than being made on a broken blade. The fracture types of the refitted pieces are not significantly different from the breaks of the other broken scrapers (Table 90). Finally, break refits of scrapers are also relevant for the issue of hafting. They generally suggest that approximately half of the total artefact length had been kept in the handle.

5.4.3.3 Scraper fabrication and 'evolution'

The making of a scraper involves a rather simple procedure of unifacial flaking. At Rekem, micro-wear analysis showed that hard hammer percussion was presumably the principle technique in this procedure. In fact, some scrapers carried marks on their ventral face that could be ascribed to use of a stone hammer during modification of the scraper fronts.

165 If the 50% rate of bone/antler scrapers is not considered, given the low number (4). On the other hand, it seems that these items tend to behave like burins in this respect.

These observations are further supported by the presence of some scrapers with partially crushed edges, damage that was undoubtedly caused by hard hammer percussion. The removal of the very small 'secondary' retouch chips to refine the scraping edge (*i.e.* to remove the tiny spurs between the larger retouch flakes), probably required a secondary retouch round, although we cannot completely exclude simple abrasion or the pressing of the tool onto an anvil. In any case, this procedure only occurred immediately before utilisation (see above). Finally, some scrapers may have been manufactured using soft-hammer percussion (with antler or wooden hammers), especially those with low-angled fronts with regular laminar, sub-parallel retouch removals (*e.g.* Pl. 97: 1). According to experiments by Rigaud[166], it is quite unlikely that such specimens could be generated using hard-hammer percussion.

As opposed to burins, scrapers are basically a 'stable' type of tool. They may reduce in length but otherwise represent more or less the same 'type' throughout their entire use-life. At Rekem, no transformations could be documented from scrapers to other type of tools or *vice versa* (although some truncations might be viewed as scraper-heads discarded in the course of resharpening; section 5.5.2).

However, there were obviously a number of changes in the size and shape of the scrapers during their use-lives. Next to an evident decrease in general length, there seemed to be an increase in the extension of the retouched scraping edge. It was, for instance, noted that the length of scraping edges on early discarded broken blade scrapers was shorter than on complete blade scrapers. It was also slightly less extended on 'long' blade scrapers than on the shorter variants (see above), suggesting that shorter scrapers at the time of abandonment were more intensely retouched than the longer specimens. On the other hand, there was apparently no decrease in scraping edge convexity (see above, and fig. 72). This contradicts the claim that resharpening towards a (presumed) haft would inhibit the creation of a rounded working edge[167]. Neither could an increase in working edge angle be documented (see above, and fig. 71). This confirms the experiments by Rigaud[168] who showed that this feature was, in fact, quite unstable over the repeated modifications with sometimes steadily increasing angles from 60° to 80°/90°, but that a sudden sharpening would then take place.

Some attributes, however, probably occurred more frequently on abandoned scrapers – available in the archaeological assemblage – than in earlier phases of the artefacts' exploitation. These are specifically the tooling accidents (pronounced overhangs, crushed edges, concavities in the scraping edge outline,...) that hindered further rejuvenation and which led to the discard of the tool. These features deserve further consideration.

5.4.3.4 Discard of scrapers

As stated earlier, stone tools are discarded when they break or are worn out, and when rejuvenation is not considered to be worth the effort or, in the case of tooling accidents, when the artisan is prevented from (re-)achieving the appropriate design. They may also be abandoned once a tool's task has been accomplished, or they may simply be 'lost'.

Scrapers can also be abandoned for several reasons. The efficacy of these tools depended on the accuracy of the scraping edge cut (its scraping potential) on the one hand, and on the 'manipulability' of the *support* on the other hand. Once the scraper broke, or became too short (less than 2.5 cm to 2 cm), further reduction was no longer useful, if possible at all. The tool was than discarded, either without any further rejuvenation attempt, or else in the course of resharpening, but leaving an unregularised edge (*i.e.* with spurs). Experiments with hafted scrapers have shown that the haft began to noticeably inhibit the resharpening of an end-scraper when the scraper reached a length of about 35 to 30mm, with 22mm of the proximal end of the scraper covered by the handle[169]. Such observations could explain why complete (flake) scrapers at Rekem began to be steadily abandoned at a length of 36mm, and systematically before they became less than 22mm long (fig. 62).

Over the use-life of a scraper, the scraping efficacy was not primarily dependant on the variation in the scraper angle (Table 98), the thickness of the scraper-head (Table 99) nor on tooling accidents affecting the distal end of the retouch flakes. Hinging scars creating pronounced overhangs, however, could possibly prohibit further rejuvenation. Other tooling accidents such as small concavities (notches) in the scraping edge outline, or crushed edges (*i.e.* damage induced by the hammer), both impeded functional efficacy and probably also hindered reparation. Items with such features were consequently rapidly discarded. Another potential cause of rejection was of course the occurrence of irregularities in the blank.

As stated for the burins, other possible causes for abandonment may also have existed such as loss or the completion of the task for which they were made. In any case, it is clear that the Rekem scrapers were frequently abandoned before complete exhaustion. Specific causes for the discard of the individual scrapers are tentatively presented in the spatial analysis (chapter 6).

5.4.4 Discussion

As probably the most common Stone Age tool-type, scrapers generally do not receive much particular attention in typo-technological discussions. We do not actually wish to alter that practice, but a few issues may be considered in view of future analyses.

When common characteristic features of Arched Backed Piece assemblages are defined, scrapers nor-

166 Rigaud 1977, 19.
167 Morrow 1997, 77.
168 Rigaud 1977.
169 Morrow 1997, 78.

mally take a prominent position. Most definitions stress that the process of 'Azilianisation' is marked by the 'shortening' of scrapers[170]. The length of end-scrapers is of course dependent on the interplay between the original blank length and the degree of tooling. Both can be highly variable. At Rekem, various blank sizes were used, but refits and other observations showed that the degree of resharpening was definitely co-responsible for scraper the variability in scraper length. The length of blanks is moreover related to the quality and availability of lithic material, which in turn might explain why considerable variation in scraper sizes can be observed in *Federmesser* assemblages from different regions.

Compared with the *Federmesser* scrapers of the Rhineland, for instance, Rekem scrapers seem quite long and elongated. At Niederbieber, the mean length of the scrapers equals the mean width (both are approx. 2 cm)[171] while at Rekem most scrapers are clearly longer than they are wide (fig. 67). At first sight it seems that the scrapers at Niederbieber were more completely exhausted in length. However, according to Bolus[172], most scrapers at Niederbieber were small from the start. Some blades would have been fractured intentionally to reduce their length[173]. Also the dimensions of the artefacts in general, as well as the extreme scarcity of blade scrapers at Niederbieber, suggest that most scrapers at that site were probably not shortened substantially during retouch. Dimensional differences with Rekem might therefore primarily result from the use of different blanks rather than from distinct degrees of (re)sharpening[174]. Moreover, at a site where scrapers were exploited more extensively, their relative number should be less important than at sites where rapid replacement occurred. The opposite seems the case when comparing Rekem (longer scrapers, but numerically less important) with Niederbieber (shorter scrapers, but in great numbers)[175].

At Meer II, the Belgian site that is at best comparable, the only information on scraper length is given for the 9 scrapers refitted in one block[176]. For these elements, mean length and width (37mm and 26mm respectively) are comparable with the measurements at Rekem.

In Northern France on the other hand, *Federmesser* scrapers are somewhat larger than at Rekem. For example, in the assemblages of Belloy-sur-Somme and Dreuil-lès-Amiens mean scraper lengths of respectively 44 ± 9mm, and 51 ± 14mm are recorded[177]. At both sites this 'gigantism'[178] is related to easy access to good raw material. On the other hand, double blade scrapers seem to occur in several assemblages at these sites (*e.g.* Chaussée-Tirancourt/Prés-du-Mesnil, Saleux 109).

In Great Britain, few assemblages can be compared with Rekem. At Hengistbury Head, scrapers are also somewhat larger[179]. It is not yet clear, however, how this site should be exactly related to the *Federmesser* assemblages on the continent.

Regarding scraper width, a compound histogram (fig. 64) shows that the distributions and averages of this dimension are analogous for both flakes and blades. This is very different to both the observations made in some Late Magdalenian assemblages[180] and also at Hengistbury Head[181] where the scrapers on flakes are generally wider than those on blades. This probably reflects a perceived dichotomy between blades and flakes in these societies (see chapter 4). Conversely, it also reconfirms that the distinction between flakes and blades at Rekem is essentially more a matter of research convention and arbitrary classification than the reflection of a true bimodality.

The angles of the scraping edges, mostly between 55° and 75°, are analogous with measurements at other *Federmesser* assemblages[182]. However, they are clearly somewhat steeper in comparison with the scrapers from Magdalenian (*e.g.* at Marsangy I, 80% of the scraping edge angles are ≤50°)[183] or Hamburgian sites (mostly between 30° and 60°)[184]. It has been frequently suggested that scraping edges become progressively steeper (*i.e.* edge angles increase) as a result of successive resharpening[185]. At Rekem, the lack of a correlation between the scraping edge angle and the scraper length, does not seem to support this explanation. We rather suspect that a technological cause, possibly a transition from pressure flaking or soft hammer percussion to hard hammer percussion may account for the evolution from sharp scraping edge angles in Magdalenian(-like) industries to steep angles in *Federmesser* assemblages. On the other hand, this evolution might also result from many other factors (*e.g.* changes in use modalities related to hafting).

Although they are generally not dominant at *Federmesser* sites, nevertheless the complete absence of circular scrapers, and the scarcity of double end-scrapers (only 2 on flake, none on blade) is remarkable at a site which has produced more than 1000 tools. We have partly explained this as resulting from the fact that the prominent bulbs of percussion on most blanks do not encourage the proximal installa-

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170 *e.g.* Bolus 1992.
171 Bolus 1992, 224, tab.66
172 Bolus 1992, 59
173 A procedure also observed at Rekem. We suspect that blades were intentionally broken to remove bulbs of percussion of the blank, perhaps to facilitate hafting.
174 The numerical importance of the so-called '*Kratzerabfälle*' (retouch waste of scrapers) at Niederbieber (Bolus 1992) might be somewhat overestimated as it seems that all (retouch) chips are included in this category. As such, these numbers are more an artefact of the classification criteria than a true reflection of scraper resharpening.
175 For the sake of the argument, we freely make abstraction of the fact that tool numbers are of course in the first place dependent on the activities carried out at a site.
176 Van Noten 1978, 78.
177 Fagnart 1993, 128 & 162
178 Fagnart 1993, 167.
179 Barton 1992, 110.
180 *e.g.* Marsangy; Schmider s.d..
181 Barton 1992, 110.
182 Bohmers 1956; Valentin 1995.
183 Schmider s.d., 177
184 Bohmers 1956
185 Moss 1983, 41; Barton 1992, 110; Morrow 1997, 78.

Table 114
Rekem 1984-86. Scrapers. Position of lateral modifications at the various loci.

Area of (partial) modification	Locus 1	2	4	5	6	7	8	10	11	12	14	16	Total
Left edge	2	-	-	6	3	-	-	2	-	2	1	2	18
Both edges	-	-	-	-	-	-	-	1	-	-	2	-	3
Right edge	1	-	-	4	8	1	-	-	1	2	-	-	17
Total	3	0	0	10	11	1	0	3	1	4	3	2	38
Scraper total	10	2	1	58	41	5	3	6	7	19	6	12	170
% with modified edges	30%	0%	0%	17%	27%	20%	0%	50%	14%	21%	50%	17%	22%

tion of a scraping edge. This should, however, also be true for most other *Federmesser* sites. Nevertheless assemblages from sites without proximate raw material resources do contain both circular and double end-scrapers[186]. The question therefore arises as to whether their scarcity at Rekem should also be explained by the easy access to raw material and the subsequent lack of need to fully exhaust the tools.

Another issue that deserves consideration here is the absence of tanged scrapers and of blade scrapers with continuously retouched lateral edges. The latter are known from Magdalenian and Hamburgian sites but also from Hengistbury Head[187], at the so-called Creswellian sites in the Northern Netherlands[188], in the Bromme group, and in the so-called Wehlen-facies of the *Federmesser* groups. While functional aspects, especially related to modes of prehension, may be at play here, the scarcity of this feature seems rather typical of *Federmesser* assemblages in the SW part of the NW European Plain.

Some authors[189] retain the left or right presence of lateral retouches as representing stylistic attributes, mainly because they are not co-varying with attributes that are considered to be 'functional' (length, width and thickness of the scrapers, and depth of retouches). At Rekem it may indeed be remarked that the location of lateral modifications is slightly different at the various loci (Table 114). The assemblage with the highest absolute number of lateral modifications (Rekem 6) displays, for instance, more than twice as many right as left examples (8 versus 3). Conversely, the two assemblages with the highest relative number of lateral modifications (on 1/2 of the scrapers: Rekem 10 and Rekem 14) display the only scrapers with additional retouch on both lateral edges, or else exclusively on the left edge. In general, however, the numbers are extremely limited, and it would probably not be wise to put too much weight on these few observations.

Then which observations might be rather explained in stylistic terms? A striking pattern in this regard is the orientation of asymmetrically oriented scraping edges. As shown at Rekem, left-oriented scraper-heads are exclusively associated with locus 5 and especially locus 6 (Table 93) and could not be correlated with functional aspects (Table 100). According to Bolus[190], citing Schild[191], asymmetrical scraper-heads, particularly fan-shaped forms, would be typical of the Tarnovian, a facies of the *Federmesser* industries in North-Central Europe. At Rekem, some scraper-heads might be described as 'fan-shaped' (*e.g.* Pl. 91: 5, Pl. 94: 11), but these are not particularly asymmetric.

The same author[192] further claims different 'signatures' (*Handschriften*), referring for instance to the presence of 'Aurignacian-like' nosed scrapers at Niederbieber IV. In Rekem, 6 scraper-heads were classified under the heading 'nosed' (Pl. 92: 1, Pl. 93: 13, Pl. 95: 9, Pl. 96: 4,11, Pl. 98: 9) and 7 as 'ogival' (Pl. 91: 9, Pl. 92: 7, Pl. 95: 6, Pl. 97: 9). None of these, however, can be compared with the nosed scraper edge contours at Niederbieber[193] and all were randomly distributed at the different units.

In conclusion, the scrapers at Rekem are not very standardised, a pattern that conforms to that observed at most *Federmesser* assemblages[194] and that may be primarily ascribed to technological aspects of the lithic industry (the 'unconstrained knapping standards'). The overall impression is one of notable variety and boundlessness with regard to any imposed classification attempt. The utility of the scrapers as a relevant class of tool for cross-cultural or stylistic analyses seems again rather reduced. Aspects that might deserve further consideration in that respect concern the scraper edge angle and the direction of orientation, lateral modifications, and the 'regularity' of the scraping edge morphology. Some of these are at the same time clearly related to functional aspects, as well as to modalities of prehension and hafting.

186 cf. Meer II and IV, Niederbieber IV: Van Noten 1978; Otte 1994; Bolus 1992.
187 Barton 1992.
188 Stapert 1985.
189 *e.g.* Close *et al.* 1978, 204.
190 Bolus 1992, 116.
191 Schild 1960.
192 Bolus 1992, 166.
193 It should, however, be remarked that some of the becs at Rekem approach the classification of '*Nasenkratzer*' by Bolus 1992.
194 Pace Otte 1994, 43.

5.5 Truncated blades and flakes[195]

5.5.1 Description of 'abandoned tools'

With 76 elements, the group of truncated blades and flakes is relatively well represented at Rekem. They are particularly numerous at the presumed dump spot of Rekem 1 (Table 115).

Next to 3 pieces in flint type 3, and 11 tools in fine-grained 'Hesbaye' flint, the large majority of the truncated blades and flakes (82%) are manufactured from various coarse-grained grey flint variants (Table 116). 22 elements could be ascribed to a specific flint type.

[195] After close re-examination, 16 artefacts that were formerly classified as truncated blades or flakes (cf. De Bie & Caspar 1997, table 1), have been ultimately dismissed from this tool group. The irregular distal truncation in those cases was almost certainly produced during debitage and was therefore catalogued as "spontaneous retouch" (Newcomer 1976; section 5.9).

5.5.1.1 Typology

More than three quarters of the tools included in this class are blades with one oblique truncation (58/76; Table 115). Ten blades have a transverse truncation, and two blades, both from Rekem 1, are truncated at both extremities, combining two oblique truncations in one case (Pl. 100: 4), and an oblique truncation with a transverse truncation in the other case (Pl. 100: 2). Finally, the assemblage also includes 3 obliquely truncated flakes, and 3 flakes with a transverse truncation.

Table 115
Rekem 1984-86. Inventory of truncated tools at the various loci.

	Locus											
Type	1	4	5	6	7	10	11	12	14	16	Total	%
Blade with transverse truncation	-	-	3	1	2	-	1	-	-	3	10	13%
Blade with oblique truncation	18	2	7	13	4	7	1	1	3	2	58	76%
Blade with two oblique truncations	1	-	-	-	-	-	-	-	-	-	1	1%
Blade with oblique and transverse truncation	1	-	-	-	-	-	-	-	-	-	1	1%
Flake with transverse truncation	1	-	-	-	-	-	1	1	-	-	3	4%
Flake with oblique truncation	-	-	-	2	1	-	-	-	-	-	3	4%
Total	21	2	10	16	7	7	3	2	3	5	76	100%
%	28%	3%	13%	21%	9%	9%	4%	3%	4%	7%	100%	

Table 116
Rekem 1984-86. Flint types of truncated tools at the various loci.
1. Fine-grained 'Hesbaye' flint.
2. Coarse-grained flint.
3. Mat fine grained grey flint with numerous light dots.
See section 4.2.2.2 for description of specific flint types by locus.

	Locus											
Flint type	1	4	5	6	7	10	11	12	14	16	Total	%
10	1	-	-	5	1	-	-	-	-	1		
11	-	-	-	-	-	1	1	-	-	-		
14	-	-	-	-	-	1	-	-	-	-		
Subtotal 1	*1*	*0*	*0*	*5*	*1*	*2*	*1*	*0*	*0*	*1*	*11*	*14%*
20	14	2	3	8	3	5	-	2	2	4		
21	-	-	1	-	2	-	-	-	-	-		
22	-	-	-	1	1	-	-	-	-	-		
23	-	-	-	-	-	-	2	-	-	-		
24	-	-	1	-	-	-	-	-	-	-		
25	2	-	3	-	-	-	-	-	-	-		
27	3	-	-	-	-	-	-	-	-	-		
28	1	-	-	-	-	-	-	-	-	-		
210	-	-	1	-	-	-	-	-	-	-		
212	-	-	1	-	-	-	-	-	-	-		
Subtotal 2	*20*	*2*	*10*	*9*	*6*	*5*	*2*	*2*	*2*	*4*	*62*	*82%*
3	-	-	-	*2*	-	-	-	-	*1*	-	*3*	*4%*
Total	21	2	10	16	7	7	3	2	3	5	76	100%

5.5.1.2 Dimensions

More than one third of the truncated tools are broken opposite the truncation (N=27; 36%). For the 'complete' elements with a single truncation (N=47), lengths range from 20mm to 107mm, with a mean of 42 ± 16mm. The two blades with double truncations are 55 and 58mm long. Broken items range from 13mm to 51mm in length, with a mean value of 26 ± 10mm.

The truncated tools are on average 19 ± 7mm wide, and 6 ± 3mm thick, with respective ranges between 9mm and 37mm, and between 2 and 13mm.

In all, this group of tools presents extremely variable dimensions and includes numerous small broken fragments.

5.5.1.3 General morphology

A large majority of the truncations (88%) are made on blades with more or less parallel edges and ridges, and with generally triangular or trapezoidal cross-sections (Table 117). Four blades are cortical on more than 1/3 of the dorsal surface, and 3 specimens are made on crested blades. Two truncations only are manufactured on 'irregular' flakes.

The lateral edges of the truncated tools are mostly unmodified. Seven elements, however present direct (N=6) or inverse (N=1), semi-abrupt (N=3) or marginal (N=4) retouch on the left edge (N=2), on the right edge (N=2), or on both edges (N=3).

The numerous truncated tool fragments have mostly been broken in a snap fracture (Table 118). Beside the five obliquely truncated blades that were fractured by later thermal activity, it is not clear whether the majority of breaks usually occurred before or after the manufacture of the truncation.

Table 117
Rekem 1984-86. Blank types of truncated tools.

Cross-section	Blank type: Cortical piece	Trimming piece	Parallel edges/ridges	Irregular blank	Total	%
Triangular	3	3	37	-	43	57%
Trapezoidal	-	-	29	-	29	38%
Multifacetted	-	-	1	1	2	3%
Irregular	1	-	-	1	2	3%
Total	4	3	67	2	76	100%
%	5%	4%	88%	3%	100%	

5.5.1.4 Description of the truncations

As opposed to most of the other type of tools at Rekem, truncations were not almost exclusively placed at the distal end of the blanks. One third of the truncations on unbroken tools (17/51) are proximal. The extension of the modifications ranges from 4mm to 27mm, with an average length of 13 ± 5mm. Truncations accompanied by a break facet (see below) are on average somewhat shorter (11 ± 4mm) than modifications that cover the entire extremity of the blank (16 ± 5mm).

The truncations are generally formed by direct abrupt (N=64) or semi-abrupt (N=13) retouch. One item received minimal retouch that hardly modified the original outline of the artefact (Pl. 101: 1). The thickness of the truncations is therefore quite variable and ranges from 1 to 12mm, with a mean value of 4 ± 2mm. Several (pronounced) concave truncations partly present scalariform removals, sometimes combined with severe crushing in the central part of the truncation which can be ascribed to repeated knapping (*e.g.* Pl. 100: 11).

In less than half of the cases is the entire extremity of the blank truncated (38/78; Table 119). The other

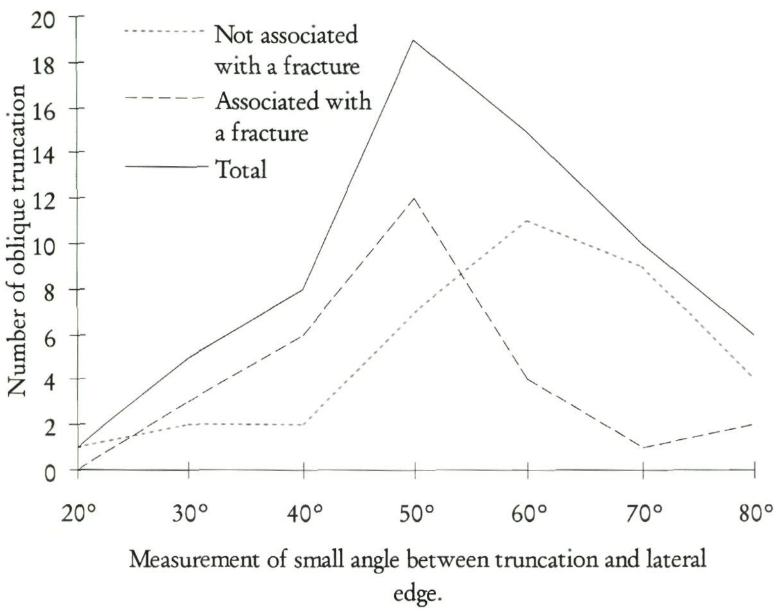
Table 118
Rekem 1984-86. Fracture types of broken truncated tools.

Type	Total number	N broken	% broken	Fracture-type: snap	feather	hinge	step	thermic
Blade with transverse truncation	10	3	30%	2	-	-	1	-
Blade with oblique truncation	58	23	40%	12	3	2	1	5
Flake with transverse truncation	3	1	33%	1	-	-	-	-
Flake with oblique truncation	3	-	0%	-	-	-	-	-
Total	74	27	36%	15	3	2	2	5

Table 119
Rekem 1984-86. Truncated tools. Outline, extent, and orientation of truncations.

Extent and orientation of truncation	Outline of truncation: Irregular	Straight	Notch	Concave	Convex	Sinuous	Total	%
Covering entire extremity								
Transverse truncation	1	3	-	3	-	-	7	9%
Oblique, right end up	1	5	-	4	1	2	13	17%
Oblique, left end up	1	9	-	5	2	1	18	23%
Covering part of extremity								
Transverse	-	2	-	-	-	-	2	3%
Oblique, left end up	-	4	-	1	-	-	5	6%
Associated with fracture	-	-	-	-	-	-	-	
Transverse	-	5	-	-	-	-	5	6%
Oblique, right end up	-	4	-	6	1	3	14	18%
Oblique, left end up	-	5	1	6	-	2	14	18%
Total	3	37	1	25	4	8	78	100%
%	4%	47%	1%	32%	5%	10%	100%	

75 *Rekem 1984-86. Truncated tools. Angles of oblique truncations.*



truncations cover only part of the extremity (N=7), or are accompanied by a break facet (N=33). In the latter case, the truncations are mostly oblique, situated either at the left (N=14) or at the right side (N=14) of the extremity. These oblique truncations are in decreasing order concave (N=12), straight (N=9), sinuous (N=5), convex (N=1), or a notch (N=1). Five truncations associated with a fracture are straight and transverse.

Truncated extremities that are not accompanied by a break facet, are also generally oblique, mostly with the left end up (N=23), less frequently with the right end up (N=13). Their shape can be straight (N=18), concave (N=10), convex (N=3), sinuous (N=3), or 'irregular' (N=2). Nine truncations are transverse with a straight (N=5), concave (N=3), or 'irregular' (N=1) outline.

The small angles formed by the oblique truncations with the general axes of the blanks usually measure between 40° and 70°, with an average of about 55°. Oblique truncations associated with a break tend to be slightly 'more oblique' (*i.e.* have a lower angle) than truncated extremities that are not partly broken (fig. 75).

More than one third of the determinable breaks adjacent to the truncations are inverse in origin (13/32; Table 120). The bulb of percussion observed in some of these breaks (N=5) shows that the coercion was in those cases applied on the dorsal face, next to the distal end of the retouch scars of the truncation. Such an origin seems only conceivable by tooling on an anvil. The occurrence of some bulbar zones in the fractures that originated from the coercion applied on the ventral face adjacent to the truncation, indicates that some of these were also accidentally provoked during the shaping of the tool. On the other hand, refitting confirmed that some pieces were clearly broken before the installation of the truncation (see below). Such items are known from many Upper and Late Palaeolithic assemblages, and are explicitly described at Gönnersdorf as "retouched breaking-edges"[196].

5.5.2 The functional significance of truncated tools

The occurrence of micro-use-wear traces in this group of tools appeared to be extremely restrained.

Twelve pieces (or 16%; Table 121) showed more or less pronounced traces of mechanical (N=6) or thermal (N=6) alteration. One of the latter could still be diagnosed microscopically, setting the number of functionally interpretable tools to 65 (86%).

Only 8 specimens (or 12%; Table 122), generally rather long items, revealed microscopic wear, never related to hafting, and always involving just one independent use zone (I.U.Z.) per piece. Most remarkably, none of these tools appeared to have been used with the truncation proper.

Six truncated elements served with an unmodified lateral edge for butchering (N=3; Pl. 100: 9, Pl. 101: 1,14), for cutting dry hide (N=1; Pl. 101: 2) or

[196] Eickhoff 1990, 311.

Table 120
Rekem 1984-86. Type and origin of fractures on truncations associated with a break facet.

Orientation and outline of truncation		Type and origin of fracture Undet. Direct	Snap Inverse	Snap Direct	Feather Direct	Hinge Inverse	Hinge Direct	Snap with bulb Inverse	Snap with bulb Inverse	Cone	Total
Transverse	straight	-	-	1	2	-	-	1	-	1	5
Oblique	straight	-	3	2	1	1	-	-	2	-	9
Oblique	notch	-	-	-	-	-	-	1	-	-	1
Oblique	concave	1	3	2	1	-	2	1	2	-	12
Oblique	convex	-	-	-	-	-	-	1	-	-	1
Oblique	sinuous	-	3	-	-	1	-	-	1	-	5
Total		1	9	5	4	2	2	4	5	1	33
%		3%	27%	15%	12%	6%	6%	12%	15%	3%	100%

Table 121
Rekem 1984-86. Use frequency of truncated tools.
* use percentage is calculated on the number of pieces suited for microwear analysis (MW) i.e. unaltered elements or pieces with limited alteration that can still be diagnosed.

Type	Total number	N altered pieces	N suited for MW	N used pieces	% used *
Blade with transverse truncation	10	1	9	1	11%
Blade with oblique truncation	58	10	48	7	15%
Blade with two oblique truncations	1	0	1	0	0%
Blade with oblique and transverse truncation	1	0	1	0	0%
Flake with transverse truncation	3	0	3	0	0%
Flake with oblique truncation	3	1	3	0	0%
Total	76	12	65	8	12%

unspecified soft animal matter (N=1; Pl. 100: 19), or for sawing bone/antler (N=1; Pl. 100: 11), the latter with a very solid, low-angled edge. Another piece was used for boring an unspecified hard material with its 'pointed' distal extremity formed by a very oblique straight truncation on the right edge and an unmodified edge on the left (Pl. 100: 13). Finally, one obliquely truncated piece has a step-terminating bending fracture with a *languette* of more than 3mm, typical of impact damage (Pl. 100: 5). Microwear analysis has revealed the presence of MLIT on this element and it can therefore be interpreted as the base fragment of a projectile point.

On the blades that were used to cut or saw with a lateral edge, five truncations are oblique and meet in an acute angle with the 'active' lateral edge. Such an arrangement may have been designed to provide the tool with a dull edge at an area where the forefinger could be placed while cutting and guiding the tool[197]. The sixth specimen, which had been employed to saw bone or antler with its very abrupt right edge (Pl. 100: 11), displays a very irregular (scalariform) distal truncation that was clearly installed after utilisation of the tool. The truncation definitely trimmed some spots of polish. It is also severely crushed below the pronounced overhang, and could be alternatively interpreted as a (failed) attempt at the manufacture of a scraping edge (see below).

In sum, the systematic microwear analysis of the truncated blades and flakes has amply demonstrated that the 'active' part of these tools was obviously not the truncation. Apart from the few knife-like implements on which the truncation can be interpreted as an accommodation to comfort the cutting task, the majority of these tools may rather be interpreted as elements discarded in the course of the fabrication (or resharpening) of a range of other type of tools. In fact, some elements provide clues that allow us to tentatively interpret them more precisely in this direction.

Five pieces have a transverse (N=3) or slightly oblique (N=2), straight (N=3) or irregular (N=2) truncation covering the distal end partly (N=1) or completely (N=4). They would not be out of place in a scraper use-life scenario. The partial truncation on one implement (Pl. 100: 17) could represent the initiation of a scraping edge that was unsuccessful because of the hinging distal end of the blank. Three other truncations have fine indentations and in two cases a small concavity in the central part of the truncated edge (Pl. 100: 15,20). These are features that have also been repeatedly found on (discarded) end-

197 Cf. Bordes 1970, 201.

Table 122
Rekem 1984-86. Determination of uses on truncated tools.
* calculation of use percentage is based on number suited for microwear analysis (MW).

Type	Total number	N suited for MW	Type of use: Cutting soft animal matter	Cutting hide	Sawing bone or antler	Butchering	Boring unspec. hard matter	Projectile point	Number used	% used*
Blade with transverse truncation	10	9	-	-	1	-	-	-	1	11%
Blade with oblique truncation	58	48	1	1	-	3	1	1	7	15%
Other truncated tools	8	8	-	-	-	-	-	-	0	0%
Total	76	65	1	1	1	3	1	1	8	12%

scrapers. The truncation on the final item (Pl. 100: 11), mentioned earlier as it was formerly used to saw bone or antler, shows a very pronounced overhang and a severely crushed edge due to repeated attempts at retouching. Its type of flint (5/22) is identical to refitting set 05s95, which includes two 'true' end-scrapers (Pl. 91: 15, Pl. 92: 2). All these truncated tools are evidently reminiscent of scrapers discarded in the course of resharpening.

Four other specimens, presenting a straight (N=2) or concave (N=2) oblique truncation at the distal end, may be better associated with burins. Two truncations affected by later breakage (Pl. 100: 16, Pl. 101: 16) contain the distal extremity of what seems to be a burin spall scar that perpendicularly cuts off the truncation. A third element (Pl. 100: 7) has a truncation adjacent to a lateral facet of which the origin cannot be determined (either from a burin blow or from the original debitage). The presence of a tertiary modification on the adjacent ventral surface, also frequently encountered on 'true' burins, suggests that this piece might well represent an atypical Lacan burin. The final specimen (Pl. 100: 12) has some inverse, very short hinging removals at the meeting point of the distal truncation with the unmodified right lateral edge, that might reflect repeated failing attempts of burin spall removal. This tool moreover refits in co-set 05c03 comprising 13 'true' burins (section 5.3.4.1).

One small thermally fractured fragment (Pl. 101: 10) carries an oblique notch-like proximal truncation that meets in a pointed trihedral extremity with the unmodified left edge. Bifacial minute damage scars on this edge suggest that the 'pointed' projection probably served for boring in a back and forth twisting movement. We recall that another truncated tool was also used as a boring implement (Pl. 100: 13).

At least 6 elements with a very oblique truncation at the proximal (N=3) or the distal end (N=3) display certain affinities with the laterally modified laminar pieces (LMP). One (Pl. 101: 5) is associated with a transverse snap fracture with a bulbar zone, situated next to the distal end of the retouch scars of the truncation. Such an inverse break has probably been caused by a 'counter-blow' during tooling on an anvil, and the analogy of this tool fragment with some of the 'manufacturing accidents' of LMP is striking (see above, *e.g.* Pl. 72: 13). It is likely that the 5 other obliquely truncated tools of this series (Pl. 100: 14,19, Pl. 101: 6,7,8) actually represent barely commenced production steps of laterally modified points. Three of those, as well as the broken tool mentioned before, were actually retrieved from the specialised LMP manufacturing station of Rekem 7[198].

A final piece (Pl. 101: 4) has a concave, very oblique truncation, at its distal end adjacent to an oblique inverse snap-terminating bending fracture. These features are opposed to a narrow proximal end with two minutely retouched edges. The edge opposite to the truncation contains a fine burination (L=9mm) initiating at the break facet and terminating in a step. Although there are no MLIT, this damage asserts that the piece was used as a projectile head. Its general morphology evokes the large 'tanged' point that was also found at Rekem 6 (Pl. 71: 24).

Together, these examples show that the group of truncated pieces should primarily be regarded as a very heterogeneous class of tools with potential links to all other type of tools. It is not inconceivable that numerous other truncations also originated in those diverse contexts.

5.5.3 Dynamic approach: use-lives of truncated tools

From the conclusions in the previous section, it is obvious that we should not expect to find a clear-cut use-life model for truncated tools. Many of these items were probably generated as shaping mishaps from an assorted scala of tool manufacturing processes. The 'consumption' (use and resharpening) of the truncation was therefore not an end in itself.

In such a perspective, it is somewhat surprising to find a rather low rate of refitting success. Only 12 elements (16%) have been conjoined with at least one other artefact (Table 123). Ten are involved in sequential refitting (Table 124, codes 1 and 24), 2 equally and 2 exclusively in break conjunctions. It is

Table 123
Rekem habitation zone 1. Truncated tools. Refitting results at the various loci.

	Locus										
Refitting type	1	4	5	6	7	10	11	12	16	Total	% refitted
Reduction sequence	4	-	3	-	1	-	-	-	-	8	11%
Fracture	-	-	-	1	-	1	-	-	-	2	3%
Reduction+fracture	1	-	1	-	-	-	-	-	-	2	3%
Total refitted pieces	5	0	4	1	1	1	0	0	0	12	16%
Not refitted	16	2	6	15	6	6	3	2	5	61	84%
Total	21	2	10	16	7	7	3	2	5	73	100%
% refitted	24%	0%	40%	6%	14%	14%	0%	0%	0%	16%	

198 Caspar & De Bie 1996.

our impression, however, mainly from a reading of the variability of the raw material, that an intensified extension of the refitting program would have shown that more items had been produced locally. In fact, only 1 truncated piece (Pl. 101: 9), recovered from the habitation of Rekem 10, is clearly an exogenous product, given its deviating flint type.

5.5.3.1 *Refitting of truncated tools in production sequences*

There are two indications of a 'serial production' of truncated blades. Refit-set 01s42 conjoins a blade with two opposed oblique truncations with another obliquely truncated blade (Pl. 100: 2) and set 01s50 reassembles two truncated tools (Pl. 100: 6) with a fragment of an LMP (Pl. 68: 25). Furthermore, one of the obliquely truncated blades, used as a butchering knife (Pl. 100: 9), refits in set 05s059 onto a large unmodified crested blade that had served for the same activity (Pl. 100: 10 + Pl. 107: 6). This latter artefact probably had not required a comparable retouched accommodation because of the 'naturally convenient' outline at its distal end. Other truncated tools refit in sets with burins, LMP, and other retouched elements (Table 125). This variety is hardly surprising in view of the interpretations offered above.

In 7 cases, the amount of flint material that had disappeared by the installation of the truncations could be measured (*e.g.* Pl. 100: 2,10). On two pieces, the length of the blanks appeared to be hardly reduced (< 4mm). In 5 other occasions, it amounted to more than 1 cm. Two of those tools were interpreted as discarded scrapers, 1 was used as a butchering knife, another might be the result of failed LMP production, and the last one refits in a set with 3 burins. In all, it seems unlikely that those elements provide us with a representative magnitude of length reduced by truncations.

5.5.3.2 *Refitting of broken elements*

In 3 of the 4 break refits the truncated blade fragment is connected with an unmodified part of the blank in a simple snap fracture opposite the truncation (*e.g.* Pl. 100: 11). In one occasion only, in co-set 01c10, we were able to successfully refit a truncation accompanied by a break facet to an unmodified blank fragment in that fracture. The combination showed that the snap fracture was clearly caused by (voluntary?) breaking before the installation of the (partial) truncation.

5.5.3.3 *Fabrication and 'evolution'*

There is some evidence for the fabrication of truncations. Firstly, the presence of crushed edges in the central part of some truncations suggests tooling with a stone hammer. Secondly some inverse snap fractures with a bulbar zone adjacent to the truncation are indicative of a tooling process on an anvil. It is unlikely, however, that these observations are representative of the fabrication of all truncations.

The 'evolution' of these tools is, of course, also very disparate. As shown, the fabrication of most other types of tool involves the shaping of a truncation at some place in their manufacturing process. Most obvious are burins on truncation (see section 5.3.4.3), but also scrapers, becs, and LMP may have had 'truncation phases'.

Because no refitting of retouch flakes took place, it is difficult to accurately evaluate the possible degree of 'rejuvenation' on truncations. In general, however, the decrease in length seems rather reduced. This is not only shown by the reduction refits and the fact that truncations accompanied by a fracture hardly shortened the tool, but also by the fact that most proximal truncations seem to have remained very

Table 124

Rekem habitation zone 1. Origin of truncated blanks as evidenced by dorsal-ventral refitting and by flint type analysis.

Legend for origin of blank:

1. Refitted in a local reduction sequence including debitage waste material.
2. Unrefitted, but debitage waste material of this specific flint type is refitting at the locus.
24. Refitted with other tool only, but debitage waste material of this specific flint type is refitting at the locus.
3. Unrefitted, but member of a specific flint type including non-refitting debitage waste material at the locus.
5. Unrefitted and member of an unspecified flint type.
6. Unrefitted member of a flint type lacking debitage waste material.

	Locus										
Origin of blank	1	4	5	6	7	10	11	12	16	Total	%
1	3	-	4	-	-	-	-	-	-	7	10%
2	1	-	3	1	2	1	3	-	-	11	15%
24	2	-	-	-	1	-	-	-	-	3	4%
3	-	-	-	2	-	-	-	-	-	2	3%
5	15	2	3	13	4	5	-	2	5	49	67%
6	-	-	-	-	-	1	-	-	-	1	1%
Total	21	2	10	16	7	7	3	2	5	73	100%

Table 125

Rekem habitation zone 1. Compilation of refit-sets in which several tools are conjoined, including at least one truncated tool.

	Tool type				
Refit-set	Truncation	Burin	LMP	Retouched	Total
01s42	2	-	-	-	2
01s50	2	-	1	-	3
05c03	1	13	1	1	16
05c12	1	3	-	-	4
07s36	1	-	1	-	2
Total	7	16	3	1	27

near to the butt of the blank. After all, a limited rate of reduction is hardly surprising, as rejuvenation seems pointless in view of the lack of any obvious use (and thus wearing out) of the truncation.

In this *Federmesser* industry, it seems unlikely that truncations mainly served to reduce blades in length in order to adapt them for an insertion into an haft, analogous, for instance, to truncated sickle blades in Neolithic contexts[199].

5.5.3.4 Discard

Because of the complete absence of use-wear on the truncations, it can be excluded that these tools were discarded because the modified part was 'worn out'. In the case of the uses as cutting implements with unmodified edges, however, the 'dulling' of the cutting edge may obviously have been an evident cause of rejection.

In many other cases, the discarded items may rather be interpreted as (frequently broken) tooling accidents that prevented the artisan from achieving the tool he had had in mind. Also in the course of resharpening scrapers, for instance, some failed attempts may have led to the discard of 'truncated' tools.

5.5.4 Discussion

In the analyses of *Federmesser* assemblages, truncated tools never occupy a predominant position and seldom are they explicitly interpreted. In the literature, it has been propounded that truncated tools resemble burins so closely that "*un seul coup de burin aurait suffi à leur donner la forme de ceux-ci*"[200]. Others likewise have suggested that some of these tools might be "*unstruck burins*"[201]. We believe there is no reason to strictly integrate this tool group into burin use-lives. We have clearly demonstrated that some obvious affinities to other type of tools should equally be considered.

However, the opposite situation also occurs. Pieces classified as atypical Lacan burins, for instance, are essentially truncated tools (on a former burin), and discarded scrapers also occasionally approach truncated tools (*e.g.* Pl. 94: 6, Pl. 97: 14, Pl. 98: 10). The same actually applies for broken (angled) backed points (*e.g.* Pl. 68: 15,20, Pl. 73: 17) and for some becs with only a slightly modified second edge (*e.g.* Pl. 102: 17,18,24).

In all, there is little reason to assume that truncated pieces in *Federmesser* assemblages were well-defined types of tool, intentionally designed for one specific set of activities.

5.6 Becs/borers/reamers

5.6.1 Description of 'abandoned tools'

This group of tools comprises 41 elements, and is therefore numerically clearly less important than LMP, burins, or scrapers. Only the assemblage from Rekem 10 includes more becs/borers/reamers than scrapers (Table 34).

Again, more than half of these specimens are on coarse-grained grey flint, the others on various fine-grained variants, generally from the 'Hesbaye' type (Table 126). Two pieces are of flint type 3, and 1 element was too heavily burnt to permit the identification of its flint type. Six tools could be ascribed to a specific flint type.

[199] Caspar 1988. For such proposal in (Epi-)Palaeolithic contexts, compare for instance Rozoy 1978, 944.
[200] Van Noten 1978, 47.
[201] Barton 1992, 124.

Table 126
Rekem 1984-86. Flint types of becs, borers, and reamers at the various loci.
0. Undetermined (patinated or heavily burnt) flint.
1. Fine-grained 'Hesbaye' flint.
2. Coarse-grained flint.
3. Mat fine grained grey flint with numerous light dots.
See section 4.2.2.2 for description of specific flint types by locus.

	Locus									
Flint type	1	5	6	10	11	12	14	16	Total	%
0	-	*1*	-	-	-	-	-	-	*1*	*2%*
10	1	5	3	2	1	-	-	1		
11	-	1	-	-	-	-	-	-		
12	-	-	-	1	-	-	-	-		
Subtotal 1	*1*	*6*	*3*	*3*	*1*	*0*	*0*	*1*	*15*	*37%*
20	1	5	5	7	-	-	1	-		
21	-	2	-	-	-	-	-	-		
25	-	1	-	-	-	-	-	1		
Subtotal 2	*1*	*8*	*5*	*7*	*0*	*0*	*1*	*1*	*23*	*56%*
3	-	-	-	-	-	*2*	-	-	*2*	*5%*
Total	2	15	8	10	1	2	1	2	41	100%

5.6.1.1 Typology

Although the classification of individual tools was not always clear-cut, we distinguished primarily between borers (N=13) and becs (N=18; Table 127). Both these types of tool have direct retouch on both sides of the drill bit. Borers are here loosely defined as elements with a rather intensely shaped, relatively narrow drill bit forming a sharp angle. The third group, called reamers (N=10), is characterised by alternate retouch removals. We further specified the number of drills (simple or double) and separated drill fragments from more complete tools. Other attributes are again registered in the annex.

Except for 2 double becs with opposite drills (Pl. 103: 3,8), and one item that could possibly have been catalogued as a multiple bec (Pl. 102: 8), all elements in this category have a single drill bit. It should be mentioned that the borers and reamers included in

Table 127
Rekem 1984-86. Inventory of becs, borers and reamers at the various loci.

	Locus									
Type	1	5	6	10	11	12	14	16	Total	%
Simple bec	1	5	4	3	-	-	-	1	14	34%
Double bec	-	-	-	1	-	1	-	-	2	5%
Drill fragment of bec	-	-	-	2	-	-	-	-	2	5%
Simple borer	1	2	3	1	-	-	-	-	7	17%
Drill fragment of borer	-	5	-	1	-	-	-	-	6	15%
Simple reamer	-	3	-	1	-	-	1	1	6	15%
Drill fragment of reamer	-	-	1	1	1	1	-	-	4	10%
Total	2	15	8	10	1	2	1	2	41	100%
%	5%	37%	20%	24%	2%	5%	2%	5%	100%	

this inventory are often merely drill fragments (N=12; *e.g.* Pl. 102: 9-12,22,25, Pl. 103: 1-2,7). In all, only 12 items were free of breakage.

5.6.1.2 Dimensions

These tools display very diverse sizes. The lengths of the 12 unbroken elements range from 21mm to 71mm, with a mean of 41 ± 17mm. The widths of all items range between 7mm and 34mm, with a mean value of 16 ± 9mm. The mean thickness of the total sample is 6 ± 3mm, with a range of between 2mm and 13mm.

5.6.1.3 General morphology

Becs, borers and reamers at Rekem are frequently made on regular blanks with parallel edges and ridges. They have, towards the drill, triangular (N=7), trapezoidal (N=11), or multi-facetted (N=1) cross-sections (Table 128). A large number, however, are also made on cortical blanks (more than one third of the dorsal surface covered with cortex; N=11), on crested blades (N=3), or on 'irregular' blanks (N=3). Two borers are even made on burin spalls (Pl. 102: 30, Pl. 82: 7)[202]. In all, this tool category appears to have been manufactured on a rather heterogeneous sample of *supports*.

As stated above, the number of broken elements is extremely elevated. Only 12 tools (*i.e.* 29%) are 'complete', including the two double becs. Breaks are present in the drill (N=5), on the blank (N=15), or in both areas (N=9). Several characteristics suggest that breaks mostly occurred subsequent to the manufacture of the drill, *i.e.* they were generated during use or while the tool was being resharpened.

5.6.1.4 Drill bit morphology

In association with the very diverse *supports* of this tool group, the modified parts of becs, borers, and reamers are also poorly standardised. Modifications vary from very marginal retouch (N=12; especially on some hardly modified blanks of becs: *e.g.* Pl. 102: 4,15,18, Pl. 103: 4) to abrupt removals (N=19) that transformed the blanks considerably (*e.g.* Pl. 102: 14,19,23; Table 129).

Table 128
Rekem 1984-86. Becs, borers, and reamers: blank types.

	Blank type							
Cross-section	Undeterm. (fragment)	Cortical piece	Trimming piece	Parallel edges&ridges	Irregular blank	Burin spall	Total	%
Not observed	3	-	-	-	-	-	3	7%
Triangular	-	8	2	7	-	1	18	44%
Trapezoidal	-	1	-	11	-	1	13	32%
Multifacetted	-	-	1	1	-	-	2	5%
Irregular	-	2	-	-	3	-	5	12%
Total	3	11	3	19	3	2	41	100%
%	7%	27%	7%	46%	7%	5%	100%	

202 Borers made on burin spalls are also known from Hengistbury Head (Barton 1992, 112), and we equally retrieved them at Meer II (see Pl. 21: 1,2 in Van Noten 1978).

Table 129
Rekem 1984-86. Becs, borers, and reamers: some observations related to the drill bits.

Characteristics of the drill bits	Drill bit type Bec	Borer	Reamer	Total	%
Position					
Unknown	-	2	-	2	5%
Proximal	2	3	4	9	21%
Distal	18	8	6	32	74%
Orientation					
Symmetric	11	9	8	28	65%
Asymmetrical right	4	1	-	5	12%
Asymmetrical left	5	3	2	10	23%
Retouch type					
Scaled/abrupt	6	9	4	19	44%
Scaled/semi-abrupt	8	1	3	12	28%
Scaled/marginal	6	3	3	12	28%
Presence of shoulder					
Absent	17	5	6	28	65%
Left	1	-	-	1	2%
Right	2	2	3	7	16%
At both sides	-	6	1	7	16%
State					
Complete	12	7	5	24	56%
Broken at the tip	1	6	1	8	19%
Broken elsewhere	2	-	4	6	14%
Blunt tip	5	-	-	5	12%

Three quarters of the drills are placed at the distal end of the blank (N=32; Table 129). Traces of the presence of a proximal drill may well have been obliterated by the pronounced bulbs of percussion.

A majority of the drills (N=28; 65%) are symmetrical relative to the flaking axis, in the sense that the projection follows the main axis of the blank (Table 129). Asymmetrical drills (*i.e.* offset to the main axis) mostly deviate to the left (N=10), but occasionally also to the right (N=5). With the possible exception of the small fragment of Pl. 102: 22, there are no distinctly curved, *Zinken*-like drill bits that oppose a convex retouched edge to a concave modification or a notch. The majority of the drills have, on the contrary, a more or less straight projection.

Becs and reamers at Rekem generally do not present a shoulder (Table 129), and if they do, it is always limited to one side of the drill – with the exception of one reamer with two shoulders. Borers with two shoulders appear (almost by definition) more frequently (N=6; Pl. 102: 8-11,14,19) although the shoulders are never very pronounced. In all, single shoulders are generally found on the right hand side of the blank.

The sharp angles of the drill bits are between about 20° on slender borers to almost 90° on some robust becs. An average of about 60° for becs and reamers versus 50° for borers has been measured, but the determination of this angle is of course subjected to considerable 'flexibility'.

The drills of the becs, borers, and especially of the reamers are in general very short and averages about 1 cm long. The length of the retouch is not necessarily equal on both edges of the drills. When it is extremely limited at one side, the tool might rather be associated with the truncated pieces (*e.g.* Pl. 102: 17,18,24). Near to the shoulder(s), or at the meeting point with at least one unmodified edge, drills are on average also about 1 cm wide, and around 0.5 cm thick. In short, these elements are generally not fragile, carefully designed elongated piercers, but a miscellaneous sample of (mostly) massive tools of various shapes. So-called micro-piercers are completely lacking. The sturdiness of the drills is, in some cases, moreover, emphasised by the modification (blunting) of the pointed end (*e.g.* Pl. 102: 17,30, Pl. 103: 3,5).

Table 130
Rekem 1984-86. Use frequency of borers, becs, and reamers: blank types.
* use percentage is calculated on the number of pieces suited for microwear analysis (MW) i.e. unaltered elements or pieces with limited alteration that can still be diagnosed.

Type	Total number	N altered pieces	N suited for MW	N used pieces	% used *
Simple bec	14	5	10	5	50%
Double bec	2	0	2	1	50%
Drill fragment of bec	2	1	2	2	100%
Simple borer	7	2	6	3	50%
Drill fragment of borer	6	0	6	0	0%
Simple reamer	6	2	5	3	60%
Drill fragment of reamer	4	1	3	3	100%
Total	41	11	34	17	50%

5.6.2 The use of borers, becs, and reamers

Despite the heterogeneity in size and shape, this group of tools seems to have been rather intensely used in a wide range of activities. The examination of microwear traces provided the following results.

About one quarter of these pieces (11/41; 27%; Table 130) showed more or less pronounced traces of mechanical (N=9) or thermal (N=2) alteration. Four slightly altered elements still permitted a functional examination, setting the total number of tools suited for microwear analysis to 34 (83%).

Half of these specimens (N=17; Table 130) carry micro-use-wear on the modified part (drill bit). There are no tools with more than one independent use zone (I.U.Z.), nor are there any traces of prehension or hafting.

The 'active' part of these tools was obviously the drill bit. In the case of the borers, it exclusively served for boring bone or antler (N=2; Pl. 102: 19,20), or

Table 131
Rekem 1984-86. Becs, borers, and reamers. Crosstable of uses for various types.
* calculation of use percentage is based on number suited for microwear analysis (MW).

Type	Total number	N suited for MW	Type of use: Fire-lighter	Graving dry hide	Piercing dry hide	Graving bone or antler	Boring bone or antler	Piercing unspecif. matter	Number used	% used*
Simple bec	14	10	1	1	-	-	3	-	5	50%
Double bec	2	2	-	-	-	1	-	-	1	50%
Drill fragment of bec	2	2	1	-	-	-	-	1	2	100%
Simple borer	7	6	-	-	1	-	2	-	3	50%
Drill fragment of borer	6	6	-	-	-	-	-	-	0	0%
Simple reamer	6	5	-	-	-	1	2	-	3	60%
Drill fragment of reamer	4	3	1	-	-	-	2	-	3	100%
Total	41	34	3	1	1	2	9	1	17	50%

for piercing dry hide (N=1; Pl. 102: 14; Table 131). The retouched extremities of the becs were also used for boring bone or antler (N=3; Pl. 102: 1,5,15) as well as unspecified materials (N=1; Pl. 102: 25). Other becs, however, were used for grooving hard animal matter (N=1), or for a similar action on dry hide (N=1; Pl. 103: 5). Two becs, finally, present a very pronounced macro-rounding on the drill extremity, probably generated by a utilisation as fire-lighter (Pl. 102: 24,26). The reamers mainly served for boring (N=4; Pl. 102: 7, Pl. 103: 1,2,4) or graving (N=1) bone or antler. One reamer fragment has an intensely rounded (robust) drill (Pl. 102: 22), and was seemingly used as a fire-lighter.

In general, the two becs and the reamer that were used for graving have somewhat shorter drill bits (less than 1 cm) than the 11 elements that served in a rotary action (drill of 1 cm or more). No other correlation could be detected between the frequency or type of the various uses on the one hand and, for instance, width, thickness, or angles of the drill bits on the other hand. The orientation of the drills on the blanks, the type of retouch, or the type of blank supporting the drill were also of little consequence (although it might be noted that the reamer used to grave bone or antler was made on a burin spall). In fact, it seems that a wide range of drill 'styles' was considered appropriate for use. Sometimes, the particularly opportunistic application of slightly modified 'naturally convenient' drills could also be observed (*e.g.* Pl. 102: 15, Pl. 103: 4,8).

There is, in fact, only one truly relevant correlation between macroscopic features and frequency of use. This relates to the state of the drills. Seven out of eight drill bits that are broken at the tip do not exhibit any use-wear, whereas all five microscopically diagnostic pieces that retain the tip of the drill, but are fractured elsewhere, have traces of use. This correlation, of course, primarily reflects the conservation of the use-wear traces, rather than Palaeolithic use preferences. The drill bits of borers in particular are frequently broken at the tip (Table 129) and thus have lost the possible edges with use-wear.

In spite of ample attempts having been made, no other immediate correlation between morphology and use could be observed in this tool class. There is only this unexpected relationship between use frequency and the type of flint of becs, borers, and reamers, an observation that might require further explanation. More than two thirds of the implements suitable for microwear analysis made in fine-grained flint showed use (10 of 14), whereas only one third (6 of 18) of the analysable tools in coarse-grained flint displayed use-wear traces.

One implement, pictured on Pl. 102: 7, deserves special mention. It combines a diagnostic impact fracture on its proximal end with a boring activity on hard animal matter at the distal end. It seems likely that this item, found at Rekem 5, was in fact a projectile point that had been firmly shot into animal bone. It had thus received both the retouch on the unmodified edge and the microwear traces on top during attempts to remove it from the carcass and implying forceful twisting movements. Alternatively, this piece might document the intentional transformation of a recycled LMP into a borer.

In conclusion, the functional evidence shows that the becs, borers, and reamers at Rekem primarily served for boring bone and antler and occasionally for grooving it. As such, they are functionally complementary with the burins that were primarily employed to grave hard animal matter, but in 6 cases, they were also used for boring the same substance[203] (*e.g.* Pl. 80: 13, Pl. 82: 2). The depth of penetration was rather limited, reaching less than 4 to 6mm (see above).

The association between becs/borers/reamers and burins will be sustained in the following dynamic approach to these implements.

[203] It may be noted that a boring activity has also been diagnosed on one truncated tool (Pl. 100: 13).

Table 132
Rekem habitation zone 1. Becs, borers, and reamers. Refitting results by locus and by type.
* Tooling refers in this case to a bec and a reamer made on a burin spall and refitted to their parent burins, not to modification of drill bits.

Refitting type	Locus 1	5	6	10	11	12	16	Total	% refitted	Type Bec	Borer	Reamer
Reduction sequence	-	-	-	1	-	-	1	2	5%	1	-	1
Tooling*	-	1	-	1	-	-	-	2	5%	1	-	1
Fracture	-	1	-	-	-	-	-	1	3%	-	1	-
Reduction+fracture	-	1	-	-	-	-	-	1	3%	1	-	-
Total refitted pieces	0	3	0	2	0	0	1	6	15%	3	1	2
Not refitted	2	12	8	8	1	2	1	34	85%	15	12	7
Grand Total	2	15	8	10	1	2	2	40	100%	18	13	9
% refitted	0%	20%	0%	20%	0%	0%	50%	15%		17%	8%	22%

5.6.3 Dynamic approach: use-lives of borers, becs, and reamers

Despite their low numbers, we were able to some extent to reconstruct the manufacturing processes pertaining to becs, borers, and reamers, and to define the main reason for the abandonment of the artefacts. The 'consumption' rate (degree of resharpening) of these tools is less unequivocal.

Only 6 elements (15%) have been conjoined with at least one other artefact (Table 132). At least 5 of these were obviously manufactured locally (Table 133): 3 pieces are involved in sequential refitting (Pl. 103: 6,8; one of those equally in a break conjunction: Pl. 102: 1), while a bec and a reamer manufactured on a burin spall could be refitted to the parent burin (Pl. 82: 7, Pl. 102: 30). On the other hand, the deviating flint type of 1 reamer located in the intermediate area between Rekem 11 and the habitation of Rekem 10, suggests extra-local fabrication. Finally, 1 broken bec could be reassembled (Pl. 102: 8). We have not yet systematically attempted to refit the retouch flakes onto the drills.

There is no indication of a serial production of becs, borers, or reamers. On the other hand, the bec refitting in co-set 05c14 (Pl. 102: 1) is associated in this conjoinment with a burin and 3 end-scrapers. The functional analysis has shown that it was the only item to have been used on bone or antler, while all the other tools, including the burin made on the same blank (Pl. 78: 10), had been used on hide.

No other multiple tool refits could be realised with this tool-category, except for the obvious connections of the burin-spall borer and reamer with their burins. The reamer on the burin spall of set 05s98 served to grave bone or antler, an action likewise performed by both bevels of the multiple burin onto which it could be refitted (Pl. 82: 07). The borer on the burin spall of set 10s49 has no use-wear preserved, nor has its parent burin (Pl. 102: 30).

The debitage refits also allow for a measurement of the amount of material that was removed by the installation of the drills. The 3 elements refitted in a reduction sequence and the 2 refitted burin spalls appeared to have been only minimally retouched. The shape of the original blank was in fact hardly modified. We stated earlier that many tools of this category, especially becs and reamers, indeed received only marginal retouch. On the other hand, we should consider the possibility that the refitted items were quickly discarded elements, whereas the items with an extended use-life may have been transported away from their spot of initial manufacture. This was also suggested for the double bec from Meer II that could be refitted with numerous retouch flakes[204], and which therefore revealed a prolonged sequence of 'consumption' (use-resharpening).

The association of these tools with the burins, already suggested in the microwear analysis, was also documented in the dynamic analysis of the burins,

[204] Cahen, Keeley & Van Noten 1979, 666.

Table 133
Rekem habitation zone 1. Origin of blanks of becs, borers, and reamers, as evidenced by dorsal-ventral refitting and by flint type analysis.
* 1 reamer at Rekem 5 and 1 bec at Rekem 10 are manufactured on a burin spall, each refitting intra-locus with its parent burin.
Legend for origin of blank:
1. Refitted in a local reduction sequence including debitage waste material.
2. Unrefitted, but debitage waste material of this specific flint type is refitting at the locus.
5. Unrefitted and member of an unspecified flint type.
6. Unrefitted member of a flint type lacking debitage waste material.

Origin of blank	Locus 1	5	6	10	11	12	16	Total	%
1	-	1	-	1	-	-	1	3	8%
2	-	3	-	-	-	2	-	5	13%
5	2	11*	8	8*	1	-	1	31	77%
6	-	-	-	1	-	-	-	1	2%
Total	2	15	8	10	1	2	2	40	100%

where several transformations could be documented from borers/becs/reamers to burins or *vice versa* (see above). Some examples suggested that the removal of a burin spall served to rejuvenate a bec, as shown, for instance, on Pl. 79: 2: after the first attempt at manufacturing a drill bit on the left edge had snapped off, another drill had been installed on the distal end of this piece. In this state, the bec was used as a boring implement on bone or antler. Two successive burin blows had removed the drill and another 'bec' had been shaped at the same end. Again, it had been used in a rotary action on bone or antler. At the final stage, the piece had again been transformed into a burin (a flat-faced burin, not visible on the drawing) which no longer registered use-wear traces.

Other examples of associations between burins and becs presented in the burin description are pictured in the refit drawings of Pl. 82: 6 and Pl. 88: 6. The former also includes a reconstruction of 2 drill bits. In all, 6 phases of the reconstructed burin biographies typologically represent a borer or bec. Moreover, some spall scars on burins received secondary retouch (*e.g.* Pl. 81: 17) causing them to bear a close resemblance to borers or becs. Oppositely, items that were classified with the borers (*e.g.* Pl. 102: 19), because of the heavy retouch on a former spall scar, could as well have been considered true (but remodified) burins. On some other (true) borers or becs, the (distal) remnant of a former spall scar could still be observed (Pl. 102: 23).

A certain alliance between burins and becs has also been observed on other *Federmesser* sites[205] but equally at Magdalenian sites (*e.g.* Pincevent, Verberie, Arcy-sur-Cure)[206]. As stated earlier, this connection may be related to the use of these tools on similar contact materials (bone/antler) though in different motions. The occasional employment of the burin blow as a technique to rejuvenate a bec is a procedure that was also observed at the sites mentioned above[207].

Despite the high rate of broken elements, only 2 fragments could be refitted with another fragment of their blank to give an indication of their original length. This low number unfortunately does not allow for an accurate discussion or a relevant contribution to the hafting issue.

Notwithstanding the low refitting rate, the high number of broken borers, becs, and reamers suggest that these items were primarily discarded when they broke and when rejuvenation was not considered worth the effort.

5.6.4 Discussion

The becs, borers, and reamers at Rekem make up a somewhat poor class of tool, both in quantity and quality. The appearance of these implements is very diverse, and ranges from rather well designed, intensely shaped borers, to atypical, hardly modified becs, which nevertheless seem to have been mostly employed as boring implements. Part of the diversity is also due to the wide range of blanks used as *support*. Moreover, most are broken elements, ranging from small tip fragments to nearly complete elements of which only a small particle is missing.

Nevertheless, compared with many other *Federmesser*-assemblages, these tools seem still to be well represented at Rekem. In most *Federmesser* tool kits, they form an extremely limited element of the assemblages. At sites like Westerkappeln or Niederbieber in Germany, hardly any examples are known[208]. In Northern France they are also very rare[209] and very few examples were collected at Hengistbury Head[210]. At Meer II, on the other hand, borers and becs are reasonably numerous[211] and bear close comparison with the examples from Rekem.

5.7 Composite tools

5.7.1 Description of 'abandoned tools'

5.7.1.1 General presentation

The Rekem assemblage contains 20 composite tools, dispersed over most of the concentrations (Table 134). In 18 cases, they combine a burin with either a scraper (N=9; Pl. 104: 2,7-10,13, Pl. 105: 1,4,6), a truncation (N=5; Pl. 104: 1,4,12, Pl. 105: 2,5), or a borer/bec (N=4; Pl. 104: 3,5,11, Pl. 105: 3). There are two instances of a scraper combined with a truncation (Pl. 104: 6, Pl. 105: 7).

About half of the composite tools are on coarse-grained grey flint, the others on fine-grained variants, generally from the 'Hesbaye' type, or on flint 3 (Table 135). Four elements could be ascribed to a specific type of flint.

Apart from a cortical flake (Pl. 104: 13) and two other flakes (Pl. 104: 9, Pl. 105: 5) all composite tools are made on blades or laminar flakes mostly having a triangular cross-section (N=10) but occasionally with trapezoidal (N=4) or multi-facetted (N=1) cross-sections (Table 136). Two blanks are partly crested (Pl. 104: 6, Pl. 105: 4).

Fig. 76 presents a scatter diagram showing the length and width of the different types of composite tools. Whereas length is not significantly different for the various categories (mostly between 3 and 5mm), there seems to be a certain variation in width and thickness. For example, burin-borer/bec types are, on average, clearly narrower (18 ± 9mm) and thinner (6 ± 2mm) than burin-scraper types (26 ± 6mm wide and 10 ± 3mm thick). In fact, these differences correspond more or less with the general

[205] *e.g.* at Meer II; Cahen in Van Noten 1978.
[206] Cahen *et al.* 1980, 219; Cahen in Audouze *et al.* 1981; Valentin 1995, 280.
[207] Cf. Keeley 1978, 81: "... *there is evidence from the conjoinable implements that the burin blow was an alternative method of resharpening becs...*"
[208] Günther 1973, Bolus 1992.
[209] Fagnart 1997.
[210] Barton 1992.
[211] Van Noten 1978.

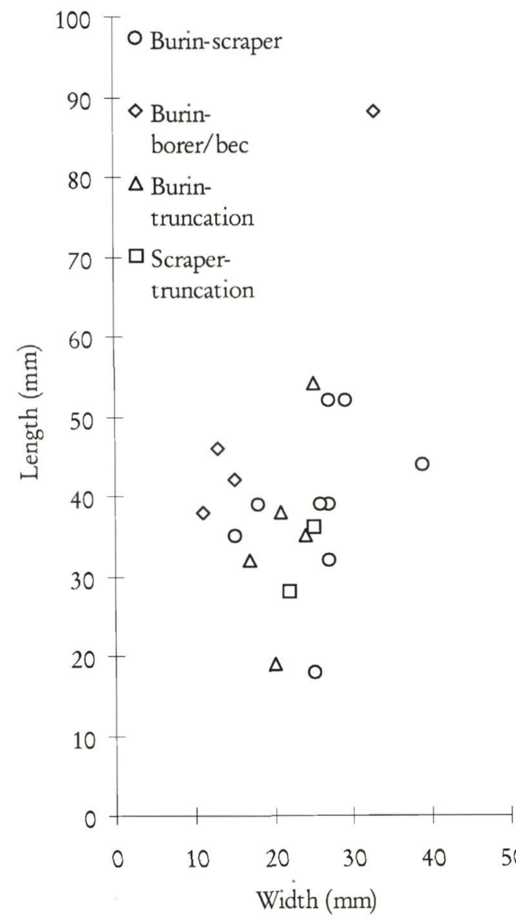
Table 134
Rekem 1984-86. Inventory of composite tools at the various loci.

Type	Locus 1	5	6	7	10	11	12	14	16	Total
Burin-scraper	-	2	2	1	1	1	1	1	-	9
Burin-borer/bec	-	2	-	-	2	-	-	-	-	4
Burin-truncation	2	1	-	-	1	-	-	1	-	5
Scraper-truncation	-	-	1	-	-	-	-	-	1	2
Total	2	5	3	1	4	1	1	2	1	20

Table 135
Rekem 1984-86. Flint types of composite tools at the various loci
1. Fine-grained 'Hesbaye' flint.
2. Coarse-grained flint.
3. Mat fine grained grey flint with numerous light dots.
See section 4.2.2.2 for description of specific flint types by locus.

Flint type	Locus 1	5	6	7	10	11	12	14	16	Total
10	-	3	1	-	-	1	-	1	-	
11	-	-	-	-	2	-	-	-	-	
Subtotal 1	*0*	*3*	*1*	*0*	*2*	*1*	*0*	*1*	*0*	*8*
20	1	1	1	1	2	-	1	1	1	
21	1	-	-	-	-	-	-	-	-	
23	-	1	-	-	-	-	-	-	-	
Subtotal 2	*2*	*2*	*1*	*1*	*2*	*0*	*1*	*1*	*1*	*11*
3	-	-	*1*	-	-	-	-	-	-	*1*
Total	2	5	3	1	4	1	1	2	1	20

76 *Rekem 1984-86. Length-width measurements of composite tools.*



different dimensions of respectively borers/becs/reamers (W=16 ± 9mm; Th=6 ± 3mm) and scrapers (W=25 ± 9mm; Th=8 ± 3mm).

5.7.1.2 Description of tooling ends

A detailed classification of all the tooling end types (N=40) is presented in Table 137. Interestingly, the relative number of tooling ends on composite tools (45% burin ends, 28% scraper-heads, 18% truncations, and 10% drills borers/becs) corresponds well with the mutual ratio of the same type of tools in the whole Rekem assemblage (49% burins, 30% scrapers, 14% truncations, and 7% borers/becs)[212]. At first sight, this seems to indicate that composite tools might not be purposefully designed combinations, but a result of the casual creation of different

Table 136
Rekem 1984-86. Blank types of composite tools.

Blank type	Composite tool type: Burin-scraper	Burin-borer/bec	Burin-truncation	Scraper-truncation	Total
Cortical piece	1	-	-	-	1
Trimming piece	1	-	-	1	2
'Regular' blank with triangular crossection	5	3	2	-	10
'Regular' blank with trapezoidal crossection	1	1	1	1	4
'Regular' blank with multifacetted crossection	-	-	1	-	1
'Irregular' flake	1	-	1	-	2
Total	9	4	5	2	20

[212] Lateral modified (laminar) pieces and randomly retouched tools are for obvious reasons disregarded in this calculation.

tooling ends on the same blank at different moments in time. We will return to this hypothesis in the discussion on the use-lives of these implements.

All the attributes that were earlier recorded on the singular tool types described above have also been registered for the individual tooling ends of the composite tools. These characteristics can be found together with the functional data in annex 2, and are briefly summarised here for each tooling end type.

Burin ends
As can be deduced from Table 137, the position of the burin facet on the blank is lateral on 9 burin edges, medial (oblique) on 8, and transverse on 1 burin end. Except for the 4 burins on a break, which have a transverse platform and the single transverse burin on a retouched edge, all burin ends present oblique spall platforms. The mean length (19 ± 11mm), width (5 ± 2 mm) and number (1.5) of the spall scars on the composite tools is almost identical to the measurements on the 'simple' burins (see above). The same is true for the mean value of the burin angles (74 ± 13mm).

The spall platforms on the burins on a break (N=4), were all created voluntarily by percussion on the central ridge of the dorsal face of the blank (Pl. 104: 8,9, Pl. 105: 1). Spall platforms on dihedral burins are characterised by a single spall scar. One trihedral burin presents flat retouch on the ventral face of the blank adjacent to the spall platform (Pl. 104: 12).

Half of the composite tools with a burin end have laterally modified edges (Pl. 104: 3-5,7,11-13, Pl. 105: 3-4), often at both sides, consisting of fine continuous retouch or tiny scars that have slightly blunted the edges. On truncation burins, this feature sometimes passes gradually from the oblique truncation to the marginal retouch (Pl. 104: 4, Pl. 105: 4).

The burin edge on composite tools is situated more at the proximal end of the blank (N=10) than on the distal extremity (N=8). This is somewhat different to the situation on the burins proper, where only 20% of the burin ends were proximal (section 5.3.1.3). The terminal spall scars on the burin edges were placed either on the left (N=10) or on the right (N=8) side of the blank. There is no preference for a deviation to the left (N=4) or to the right (N=4) of the burin edge, relative to the axis of the blank, in the case of asymmetrical positions. Most burin tips (N=10) are more or less axial.

The outline of the spall platforms is rectilinear on the dihedral burins and on the burins on a break, concave on the transverse burin on lateral retouch, and either rectilinear (N=5), concave (N=2), or convex (N=2) in the case of the truncation platforms.

A small majority of the spalls (N=10) were removed squarely from the burin, forming a burin facet in a right angle with the ventral face of the blank. Obtuse burin facets are slightly canted either on the

Table 137
Rekem 1984-86. Typology of tooling ends on composite tools at the various loci.

	Locus									
Type of tooling end	1	5	6	7	10	11	12	14	16	Total
Lateral burin on transverse break	1	1	1	1	-	-	-	-	-	4
Lateral burin on oblique truncation	1	-	-	-	-	-	-	-	-	1
Medial burin on oblique truncation	-	2	-	-	1	-	1	-	-	4
Transverse burin on retouched edge	-	-	-	-	-	1	-	-	-	1
Lateral atypical Lacan burin with oblique truncation	-	2	-	-	-	-	-	1	-	3
Medial atypical Lacan burin with oblique truncation	-	-	-	-	1	-	-	-	-	1
Lateral dihedral burin with oblique spall platform	-	-	-	-	1	-	-	-	-	1
Medial dihedral burin with oblique spall platform	-	-	1	-	1	-	-	1	-	3
Total burin bevels	*2*	*5*	*2*	*1*	*4*	*1*	*1*	*2*	*0*	*18*
Simple long endscraper on blade (L>=2W)	-	1	-	-	-	-	-	1	-	2
Simple short endscraper on blade (L>2W)	-	1	3	-	1	-	1	-	1	7
Simple endscraper on flake	-	-	-	1	-	1	-	-	-	2
Total scraperheads	*0*	*2*	*3*	*1*	*1*	*1*	*1*	*1*	*1*	*11*
Simple bec	-	1	-	-	2	-	-	-	-	3
Simple borer	-	1	-	-	-	-	-	-	-	1
Total drills	*0*	*2*	*0*	*0*	*2*	*0*	*0*	*0*	*0*	*4*
Blade with transverse truncation	2	1	1	-	-	-	-	-	-	4
Blade with oblique truncation	-	-	-	-	1	-	-	1	1	3
Total truncations	*2*	*1*	*1*	*0*	*1*	*0*	*0*	*1*	*1*	*7*
Grand total	4	10	6	2	8	2	2	4	2	40

ventral (N=2) or on the dorsal face (N=3) of the tool. The sample further includes 1 flat-faced burin facet (on the ventral face) and 2 'polyhedral' facets canting on both the ventral and the dorsal faces. Most spall scars have a 'regular' distal end but there are 5 examples of hinging burin spalls (Pl. 104: 3,4,10, Pl. 105: 4) and 1 burin end has suffered from a plunging spall (Pl. 104: 1). In the latter case, the proximal end of the burin has been truncated, creating some kind of 'alternative' atypical Lacan burin (see below).

In all, except for the numerous proximal positions, which are hardly surprising in a context of composite tools, the general appearance of the burin ends on the composite tools perfectly corresponds with the observations on the singular burins described above.

Scraper-heads

The scraper-heads are mostly placed at the distal end of the composite tools (N=9), rarely at the proximal end (N=2; Pl. 104: 2, Pl. 105: 7). This is a situation that corresponds with the positions observed on the singular scrapers (section 5.4.1.3). A majority of the scraper-heads (N=9) are also more or less symmetrical relative to the general axis of the tool. The 2 asymmetrical scraper-heads deviate once to the right (Pl. 105: 1) and once to the left (Pl. 105: 6).

The lateral edges of the composite tools that carry a scraper-head, are in general unmodified. There are only two exceptions, both combinations with burin ends. In one case, both the edges served as a retouched spall platform (Pl. 104: 13). On the other piece (Pl. 105: 4) the retouched edge seems also to be primarily related to the opposite burin end.

All scraping edges of the composite tools have a convex shape, either 'normal' (N=4; Pl. 104: 2,6,10, Pl. 105: 4), flattened (N=4; Pl. 104: 7,9,13), or sometimes ogival or nosed (N=2; Pl. 104: 8, Pl. 105: 6). The retouch patterns are mostly non-convergent (N=8) with only two semi-convergent patterns having been recorded. A transverse fracture on one scraping edge has completely destroyed its original shape (Pl. 105: 7).

The mean length of the scraping edges is 23 ± 7mm when measured as the total length of the scraping edge curve. The mean width of the scraping edges is 20 ± 7mm when measured as a straight line between the scraping edge corners. These measurements correspond better with those on the blade scrapers recorded earlier rather than with those on the flake scrapers (section 5.4.1.4). This observation matches with the blank types selected for composite tools. The thickness of the scraper-heads on these items is very diverse with an average of 7 ± 3mm. Equally diverse are the scraping edge angles, ranging between 65° and 90° and averaging 75°.

As opposed to the 'singular' scrapers, the composite tools are characterised by a majority of irregular retouch outlines on the scraper fronts. Only two scraping edges (Pl. 104: 6,13) seem to have been 'regularised' (presenting a 'smooth', plain edge; see above) whereas the other fronts present a variety of irregularities including pronounced overhangs (Pl. 105: 4), once combined with a crushed edge (Pl. 104: 7), a small concavity in the scraping edge outline (Pl. 104: 2), a fracture in the scraping edge cut (Pl. 105: 7), denticulated fronts (Pl. 104: 10), etc. Obviously, some of these tooling mishaps may have prevented further rejuvenation.

In conclusion, while many features related to the scraper-heads on the composite tools were also observed on the singular scrapers, there seems to be an increase of 'irregular' scraping edges on these items.

Truncations

Truncations were almost exclusively situated on the proximal ends of the composite tools. The one exception (Pl. 105: 7) is, at the same time, the only truncation that is accompanied by a break facet (snap). All other truncations cover the entire extremity of the tool. The extensions of the modifications range from 10mm to 22 mm, with an average length of 13 ± 4mm.

All truncations are formed by direct abrupt retouch, generating a mean truncation 'thickness' of 6 ± 3mm. As opposed to the 'singular' truncated tools, the truncations are in this case mostly transverse (Pl. 104: 1,4,6) or slightly oblique (Pl. 104: 12, Pl. 105: 5). The only exception is again the truncation accompanied by a break facet (Pl. 105: 7). The shape of the truncations is either straight (N=3; Pl. 104: 4,6, Pl. 105: 7), concave (N=3; Pl. 104: 12, Pl. 105: 5) and in one case convex (Pl. 104: 1). There are no signs of crushing on the truncated edges that could be due to repeated knapping.

In all, the truncations on composite tools diverge from those on singular truncated tools both by being predominantly transverse and by being rarely associated with a break facet.

Drills of borer and becs

The drill bits of the composite tools are rather well designed tooling ends created with abrupt or semi-abrupt retouch which transformed the blanks considerably. They are all situated opposite a burin edge, placed either proximally (N=2) or distally (N=2) and are more or less symmetrical relative to the flaking axis. They present a rather 'straight' projection, and possible shoulder(s) are certainly not prominent.

The angles of the bec drills are all about 70° wide (Pl. 104: 3,11, Pl. 105: 3) while the drill bit on the borer is around 50° (Pl. 104: 5). The drills are rather short (≤ 1 cm) but the retouch frequently continues on one or both edges of the tool. Near to the shoulder(s), or at the meeting point with at least one unmodified edge, drills are 4 to 10mm wide and 2 to 4mm thick.

One drill bit of a bec is broken at the tip in a direct tiny snap fracture (Pl. 104: 11). The fracture in the centre of this composite tool was clearly created during a rotary action (see below).

In short, these drills seem to be more carefully designed than the average drill bit encountered on singular borers or becs.

Table 138
Rekem 1984-86. Use frequency of composite tools.
* use percentage is calculated on the number of pieces suited for microwear analysis (MW) i.e. unaltered elements or pieces with limited alteration that can still be diagnosed.

Type	Total number	N altered pieces	N suited for MW	N used pieces	% used *	Number of I.U.Z. 1	2	Total
Burin-scraper	9	1	8	5	63%	3	2	7
Burin-borer/bec	4	2	2	2	100%	1	1	3
Burin-truncation	5	1	4	2	50%	2	0	2
Scraper-truncation	2	0	2	1	50%	1	0	1
Total	20	4	16	10	63%	7	3	13

5.7.2 The use of composite tools

Examination of microwear traces on the composite tools showed this to be a heavily used tool group. If we skip the 4 pieces with pronounced traces of mechanical alteration, almost two thirds of the composite tools carry micro-use-wear (10/16; Table 138) at either one (N=7) or both (N=3) tooling ends.

Except for 3 scraper-heads used on dry hide (Pl. 104: 10,13, Pl. 105: 4), all tooling ends served for working bone or antler (Table 139). There is a strong correlation between the type of tooling end and the type of action: scraper-heads were exclusively used in transverse actions (scraping; N=5), burin ends systematically served for graving (N=6), and the drill bits for either graving (N=1; Pl. 104: 3) or boring (N=1; Pl. 104: 5). None of the truncations appeared to be used. Other areas on these tools did not exhibit any traces of use, nor could any positive hafting traces be observed.

In the cases where both tooling ends were used, there is only one example of the tool being used on different materials. The burin-scraper of Pl. 104: 13 served for scraping dry hide with the scraping edge and for graving bone or antler with the burin end. The latter action could also be observed on the terminal refitting burin spall. The other use-combinations worked exclusively bone or antler, either in the same way, like the burin-bec combination that served twice for graving (Pl. 104: 3), or in a different way, in the case of the burin-scraper of Pl. 105: 1, where the tooling ends were used respectively for graving and for scraping.

In conclusion, although use on dry hide could be sporadically attested, the composite tools at Rekem primarily served in a context of bone or antler working. It seems that in a dynamic analysis, these tools are best approached as occasional varieties in the burin use-lives.

5.7.3 Dynamic approach: use-lives of composite tools

5.7.3.1 Refitting

Five composite tools (28%) have been conjoined with at least one other artefact, but 2 only are involved in sequential refitting, in combination with either a tooling or a fracture refit (Table 140). Two other specimens are refitted with burin spalls (Pl. 104: 12,13) and 1 in a break conjunction (Pl. 104: 11). Because of the low number of tools in this category, the refitting rate cannot be accurately compared with

Table 139
Rekem 1984-86. Composite tools. Crosstable of uses for various types of tooling ends.
* calculation of use percentage is based on number suited for microwear analysis (MW).

Type	Total number	N suited for MW	Type of use: Scraping dry hide	Scraping bone or antler	Graving bone or antler	Boring bone or antler	Number used	% used*
Burin end	18	14	-	-	6	-	6	43%
Scraperhead	11	10	3	2	-	-	5	50%
Drill bit	4	2	-	-	1	1	2	100%
Truncation	7	6	-	-	-	-	0	0%
Total	40	32	3	2	7	1	13	41%

Table 140
Rekem habitation zone 1. Composite tools. Refitting results by locus and by type.

Refitting type	Locus 1	5	6	7	10	11	12	16	Total	% refitted	Burin-scraper	Burin-borer/bec	Burin-trunc.	Scraper-trunc.
Tooling	-	-	-	-	1	1	-	-	2	11%	1	-	1	-
Fracture	-	-	-	-	1	-	-	-	1	6%	-	1	-	-
Reduction+tooling	1	-	-	-	-	-	-	-	1	6%	-	-	1	-
Reduction+fracture	-	1	-	-	-	-	-	-	1	6%	1	-	-	-
Total refitted pieces	1	1	0	0	2	1	0	0	5	28%	2	1	2	0
Not refitted	1	4	3	1	2	0	1	1	13	72%	6	3	2	2
Grand Total	2	5	3	1	4	1	1	1	18	100%	8	4	4	2

the other types of tool. It is evident, however, that at least some composite tools were not heavily curated items discarded far away from their spot of production, but rather were quickly abandoned implements. In fact, none of these tools was made in a truly exogenous flint type (Table 141).

There was evidently no 'serial production' of composite tools. The two elements that could be restored in their reduction sequence (Pl. 104: 1, Pl. 105: 1) are associated respectively with a burin (in co-set 01c01) and with 6 burins, a scraper, and a randomly retouched tool (in co-set 05c05). In the latter case, all elements with use-wear traces (N=8) were used on bone or antler, but in a variety of actions (sawing, scraping, graving, and boring). The presence in such a context, of a composite tool that served for both scraping and graving hard animal matter is, in fact, hardly surprising.

One of the tooling refits nicely shows how the artisan took advantage of a plunging burin spall to continue the shaping process at the opposite end, creating a so-called 'alternative' atypical Lacan burin (Pl. 104: 1, Pl. 105: 2; see above). It is also the only piece where the succession of the respective tooling ends could be reconstructed with certainty. In this case the burin end was made before the truncation. Another refit illustrates a bi-directional removal of spall scars, a procedure which occurred only on this piece at Rekem (Pl. 104: 13).

The reconstruction of the large burin-bec (Pl. 104: 11) shows that the break was clearly provoked accidentally during the use of the bec in a rotary action. Unfortunately, the piece was too heavily altered for microscopic analysis. In spite of ample attempts, we have not been able to join more tool fragments of different types in a break refit.

5.7.3.2 Fabrication and 'evolution'

As suggested in the use-wear analysis, the fabrication of composite tools should be viewed in association with the burin use-lives, especially in the case of the burin-truncation and the burin-borer/bec types.

We have already noted such association in the section on the use-lives of burins, truncations and borers/becs/reamers. Certain stages in the reconstructed use-lives of multiple burins do indeed physically corresponded with a composite tool of the burin-bec type (Pl. 82: 6, Pl. 84: 2). In general, the dynamic analysis of the burins has shown that the removal of a burin spall occasionally served to rejuvenate a borer or bec, as several transformations could be documented from drill bits to burin ends and back (see above; *e.g.* Pl. 79: 2, Pl. 82: 6, Pl. 88: 6). This was moreover confirmed in the analysis of the borers and becs where some items appeared to have preserved remnants of a former spall scar (*e.g.* Pl. 102: 19, 23).

Truncated tools, on the other hand, are in general a very miscellaneous tool category at Rekem but certain items could also be associated with the burins (see above). Moreover, truncations are an obvious part of burins in the case of truncation burins or atypical Lacan types. An 'alternative' version of the latter could in fact be observed on two composite tools, where the proximal ends have been trun-

Table 141
Rekem habitation zone 1. Origin of blanks of composite tools, as evidenced by dorsal-ventral refitting and by flint type analysis.
Legend for origin of blank:
1. Refitted in a local reduction sequence including debitage waste material.
2. Unrefitted, but debitage waste material of this specific flint type is refitting at the locus.
3. Unrefitted, but member of a specific flint type including non-refitting debitage waste material at the locus.
5. Unrefitted and member of an unspecified flint type.

Origin of blank	Locus 1	5	6	7	10	11	12	16	Total	%
1	1	1	-	-	-	-	-	-	2	11%
2	-	-	-	-	2	-	-	-	2	11%
3	-	-	1	-	-	-	-	-	1	6%
5	1	4	2	1	2	1	1	1	13	72%
Total	2	5	3	1	4	1	1	1	18	100%

cated adjacent to the spall scars that belonged with the distal burin ends and which had travelled along the entire lateral edge (Pl. 104: 1,12). It is questionable whether such specimens should actually be classified as true composite tools, or rather as alternative multiple burins.

To view the composite tools exclusively in a burin context would of course be overstated. In at least one case, it seems that the truncation opposite a scraper-head may at best be interpreted as an 'unfinished' scraping edge (Pl. 104: 6) and the tool therefore as a double end-scraper. Earlier, we also recorded truncated tools, reminiscent of scrapers, which had been discarded in the course of resharpening (section 5.5.2).

In all, it seems that 'true' composite tools (*i.e.* a purposeful combination of two different tooling end types) are indeed exceptional at Rekem and are represented primarily by the burin-scraper types. How do we explain their presence? Are the scraper-heads in those cases really purposefully designed tooling ends or are they rather coincidentally shaped edges?

Whereas some are perhaps 'atypical' (*e.g.* Pl. 104: 8,9, Pl. 105: 6; see also description above) or could alternatively be viewed as convex truncations (*e.g.* Pl. 104: 7, where the burin end served for graving bone) others are indeed probably intentionally shaped as they frequently served in transverse motions (Pl. 104: 6,10,13, Pl. 105: 4), a typical activity of the scraping edges at Rekem (section 5.4.2.1). Then what about the burin ends in those instances? Were they created to accommodate the tool for hafting (as suggested for instance for the composite tools at the Hamburgian site of Oldeholtwolde[213]) or are they autonomous tooling ends that actively served in an 'independent' action? The use-wear results seem to be ambiguous here. There are two cases where both the tooling ends were used (Pl. 104: 3,13; but only in the latter case on different materials) whereas the burin ends on the two other implements (Pl. 104: 5,10) were devoid of any microwear traces. In those cases, the burin blow therefore might possibly have served to facilitate hafting or to accommodate prehension.

In conclusion, we could argue that the artisans at Rekem were apparently not inclined towards the purposeful manufacture of different tooling end types on a single blank in order to create 'multi-functional' devices. It seems that the (relatively few) composite tools should instead be seen as the casual creations of different tooling ends on the same blank at different moments in time ('recycling'). Alternatively, in many cases, they might be regarded as 'coincidental' stages in the use-lives of other tool categories (especially burins) where the true goal of the artisan was in fact to create a tool with two equivalent tooling ends.

5.7.3.3 *Reasons for discard*

In view of the low number of composite tools and the great diversity in this category we can hardly reconstruct 'general reasons' for discard. Some items were possibly broken during use (Pl. 104: 11) or resharpening (Pl. 105: 7) or probably they became too small (Pl. 104: 13). In general, the reasons for discard discussed with each category of 'singular' tools (see above) may equally be applied here (cf., for instance, the many 'irregularities on the scraping edges, described above that may have hindered reparation).

5.7.4 Discussion

While the group of composite tools at Rekem exhibits great diversity, there seems to be one major explanation for their presence, *i.e.* their random, 'accidental' formation during production of other types of tool, especially burins. Although it cannot be fully excluded, there are no positive hafting traces that might indicate that the burin blow technique was used here as a means of facilitating hafting or prehension.

Composite tools are extremely rare at most *Federmesser* and related assemblages. At Meer II, they occur in similar proportions to Rekem but they seem to be associated more with the scrapers[214]. At other sites, they are more frequently absent then present. There are some rare examples of burin-scrapers, scraper-truncations, and borer-truncations at some of the *Federmesser* sites of Northern France[215]. One burin-scraper has also been recorded at Hengistbury Head[216]. No composite tools at all have been found at the various published concentrations at Niederbieber[217]. This scantiness reconfirms our impression that these tools are merely a product of coincidental fabrication rather than a reflection of true *Federmesser* design intentions.

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213 Moss 1988.
214 Van Noten 1978, 51.
215 Fagnart 1997.
216 Barton 1992, 112.
217 Surprisingly, at Niederbieber II, there appear to be some examples of plunging burin spalls with remnants of scraper-heads at the distal end (Bolus 1992, 65), suggesting that a former presence of composite tools may nevertheless have been possible at the site.

Table 142
Rekem 1984-86. Inventory of 'randomly' retouched tools at the various loci.

	Locus												
Type	1	2	5	6	7	8	10	11	12	13	16	Total	%
Blade with 'random' edge-retouch	1	-	5	2	1	-	-	-	-	-	-	9	27%
Flake with 'random' edge-retouch	2	2	5	2	-	1	5	1	-	1	1	20	61%
Unidentifiable tool-fragment	-	-	1	-	-	-	2	-	1	-	-	4	12%
Total	3	2	11	4	1	1	7	1	1	1	1	33	100%
%	9%	6%	33%	12%	3%	3%	21%	3%	3%	3%	3%	100%	

5.8 Other blades and flakes with retouched edge(s)

5.8.1 Description

Finally, the remaining group of 'randomly' retouched flakes and blades comprises 33 tools, including 20 flakes and 9 blades[218] with edge-retouch, and 4 unidentifiable tool fragments. After the composite tools, this category is numerically the least important tool group[219] and is sparsely distributed over the various concentrations (Table 142).

Table 143
Rekem 1984-86. Flint types of 'randomly' retouched tools at the various loci.
0. Undetermined (patinated or heavily burnt) flint.
1. Fine-grained 'Hesbaye' flint.
2. Coarse-grained flint.
See section 4.2.2.2 for description of specific flint types by locus.

	Locus												
Flint type	1	2	5	6	7	8	10	11	12	13	16	Total	%
0	*1*	-	-	-	-	-	*1*	-	-	-	-	*2*	*6%*
10	-	1	-	-	1	1	-	-	-	-	-		
11	-	-	2	-	-	-	1	-	-	-	-		
12	-	-	-	1	-	-	-	-	-	-	-		
Subtotal 1	*0*	*1*	*2*	*1*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*7*	*21%*
20	1	1	2	2	-	-	5	-	1	-	-		
21	-	-	-	-	-	-	-	-	-	1	-		
22	-	-	1	-	-	-	-	-	-	-	-		
23	-	-	1	-	-	-	-	-	-	-	1		
24	1	-	1	-	-	-	-	-	-	-	-		
25	-	-	3	-	-	-	-	-	-	-	-		
26	-	-	-	1	-	-	-	-	-	-	-		
28	-	-	-	-	-	-	-	1	-	-	-		
29	-	-	1	-	-	-	-	1	-	-	-		
Subtotal 2	*2*	*1*	*9*	*3*	*0*	*0*	*5*	*1*	*1*	*1*	*1*	*24*	*73%*
Total	3	2	11	4	1	1	7	1	1	1	1	33	100%

[218] The blades included in this series have not been integrated with the lateral modified laminar pieces (LMP) because it cannot be fully excluded that the partial and very marginal retouch on these elements could have been induced by non-intentional causes.
[219] After a final and scrupulous re-examination, almost half of the artefacts that were formerly catalogued as "*pièces retouchées*" (cf. De Bie & Caspar 1997), have ultimately been reclassified with the 'edge-damaged' specimens (see below). Originally, the excavator classified even more artefacts under the heading "*pièces retouchées*" than we did: compare table 2 in Lauwers 1988, 223.

Most of these tools are manufactured in coarse-grained grey flint (Table 143). 16 items could be tied to a specific flint type, and 2 pieces were too heavily burnt to permit the identification of their raw material.

The blades and flakes have often more or less regular parallel edges and ridges, but the category also includes 5 cortical pieces (1 blade and 4 flakes), 2 trimming flakes, and 7 'irregular' flakes. Twelve elements are broken.

The dimensions of these artefacts are extremely varied (fig. 77). The lengths range from 6mm for an unidentifiable tool fragment to 83 mm for a retouched blade. The mean length of all items is 39 ± 19mm. The mean width of the sample is 25 ± 9mm and this dimension ranges from 6mm to 48mm. The pieces are on average 7 ± 3mm thick.

Retouch on these artefacts seems randomly distributed, although it is generally restricted to one edge of the blank. It is mostly very marginal or semi-abrupt and generally did not intensively modify the outline of the edges. Most elements (85%; Table 144) have received direct retouch delimiting a straight (N=10), convex (N=8), concave (N=2), or sinuous (N=1) outline. Five edges are denticulated and the sample includes 2 notched pieces. Five other pieces have a rectilinear modified edge with inverse, again mostly marginal (N=3), retouch.

5.8.2 The functional significance of 'randomly' retouched flakes and blades

Examination of microwear traces on these elements provided the following results.

One third of the pieces (Table 145) showed traces of mechanical (N=9) or thermal (N=2) alteration to a greater or lesser degree. Three of those still allowed functional analysis, setting the total number of functionally interpretable tools to 25 (76%).

Only 2 blades and 1 flake with random edge-retouch, all from Rekem 6, carry evidence of use (12%; Table 145). The proximal parts of 2 pieces probably served as fire-lighters (Pl. 106: 6,7) and the retouched end of 1 element was used for bone scraping (Pl. 106: 8).

Table 144
Rekem 1984-86. Randomly retouched tools. Outline, type, and origin of retouch.

Type and origin of retouch		Outline of retouched edge: Straight	Denticul.	Notch	Concave	Convex	Sinuous	Total	%
Scaled/abrupt	Direct	-	1	1	2	2	-	6	18%
	Inverse	1	-	-	-	-	-	1	3%
Scaled/semi-abrupt	Direct	5	3	1	-	1	1	11	33%
	Inverse	1	-	-	-	-	-	1	3%
Scaled/marginal	Direct	5	1	-	-	4	-	10	30%
	Inverse	3	-	-	-	-	-	3	9%
Scaled/flattened	Direct	-	-	-	-	1	-	1	3%
Total		15	5	2	2	8	1	33	100%
%		45%	15%	6%	6%	24%	3%	100%	

The evident absence of use in this group of tools suggests that most of these pieces were not purposefully designed formal tools. Next to the tool fragments which are now unrecognisable, some other pieces may be interpreted as repudiated drafts (roughouts) of 'formal' tools. By way of example, three elements have been interpreted more precisely.

One element, refitted in co-set 16s24 presents a 'naturally' convex distal end, partially modified by semi-abrupt removals. These could possibly represent an inception of scraping edge manufacture. A true scraper also refits in this co-set (Pl. 98: 10).

After close (re)examination, a blade fragment with two marginally retouched edges (Pl. 106: 4) appeared to present a short distal part of a spall scar on its left edge, adjacent to the (probably intentionally snapped) inverse fracture facet. This tool also refits in the 13-burin co-set 05c03 (see above).

Another small but rather thick element (Pl. 106: 2) presents a concave edge modified by invasive, semi-abrupt scalariform retouch, opposed to a very abrupt unmodified edge, of which the dorsal ridge presents short scalariform removals. The morphology of this trihedral part is reminiscent of the 'drill bits' of certain becs.

Other examples might be found, but in view of the absence of positive traces, this will always remain a largely speculative exercise.

Finally, it must be accepted that some retouch on these elements could be induced by non-intentional causes (*i.e.* 'retouches *à posteriori*', cf. edge-damaged pieces, section 5.9).

5.8.3 Refitting

One third of the randomly retouched tools from habitation zone 1 (10/31) could be refitted, mostly in a reduction sequence, once equally, and once exclusively in break conjunctions (Table 146). Again, we did not attempt to refit the retouch waste on the modified edges. The rather elevated refitting rate hints at a poor mobility pattern for these items (*i.e.* local manufacturing and abandonment), which cor-

77 *Rekem 1984-86. Length-width measurements of randomly retouched tools.*

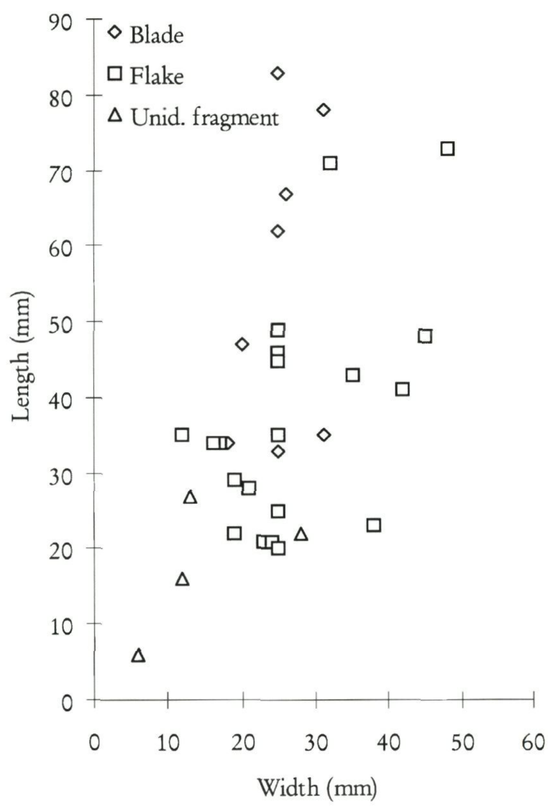


Table 145
Rekem 1984-86. Use frequency of 'randomly' retouched tools.
* use percentage is calculated on the number of pieces suited for microwear analysis (MW) i.e. unaltered elements or pieces with limited alteration that can still be diagnosed.

Type	Total number	N altered pieces	N suited for MW	N used pieces	% used *
Blade with edge-retouch	9	0	9	2	22%
Flake with edge-retouch	20	8	15	1	7%
Unidentifiable tool-fragment	4	3	1	0	0%
Total	33	11	25	3	12%

Table 146
Rekem habitation zone 1. Randomly retouched tools. Refitting results by locus and by tool type.

	Locus												Type of blank		
Refitting type	1	5	6	7	8	10	11	12	13	16	Total	% refitted	Blade	Flake	Unid. fragm.
Reduction sequence	1	2	2	1	-	1	-	-	-	1	8	26%	4	4	-
Fracture	-	-	-	-	-	1	-	-	-	-	1	3%	-	-	1
Reduction+fracture	-	1	-	-	-	-	-	-	-	-	1	3%	-	1	-
Total refitted pieces	1	3	2	1	0	2	0	0	0	1	10	32%	4	5	1
Not refitted	2	8	2	0	1	5	1	1	1	0	21	68%	5	13	3
Total N tools	3	11	4	1	1	7	1	1	1	1	31	100%	9	18	4
% refitted	33%	27%	50%	100%	0%	29%	0%	0%	0%	100%	32%		44%	28%	25%

Table 147
Rekem habitation zone 1. Compilation of refit-sets in which several tools are conjoined, including at least one randomly retouched tool.

	Tool type						
Refit-set	Retouched	Burin	LMP	Scraper	Truncation	Composite	Tool total
05c03	1	13	1	-	1	-	16
05c05	1	6	-	1	-	1	9
10s48	1	1	-	-	-	-	2
07s32	1	-	2	-	-	-	3
16s24	1	-	-	1	-	-	2
Total	5	20	3	2	1	1	32

responds well with their (non-)functional interpretation. A more profound analysis of their mobility and place of production will be integrated in a forthcoming study of the unmodified blanks (debitage).

In 6 cases, the original outline of the edges before retouch could be determined from the 'surrounding' refitted artefacts. They show that the degree of modification was in general very limited.

There is no indication of a serial production of these tools. Five of them, on the other hand, were associated in refit sets with a range of other type of tools (Table 147).

One of the fragments refitting in a break (Pl. 90: 2) shows that breakage occurred before retouching. Another fragment of this refit set was modified into a burin on a break. On the basis of the snap fractures, it cannot be determined whether the original blade was broken intentionally or whether the breaks resulted from a knapping accident during the detachment from the core. In all, however, this composition is clearly reminiscent of the 'intentional breakages' that have been described at the Late Palaeolithic site of Hengistbury Head[220].

5.8.4 Discussion

Not surprisingly, 'miscellaneous tools' and 'unidentifiable tool fragments' are a group of implements that recur in every lithic industry. They are the inevitable output of flint working and utilisation processes and may mostly be considered 'pre-forms' of formal tools, or a type of tooling waste. The analyses at Rekem clearly support this interpretation.

Inter-site comparisons regarding this group of tools are hardly possibly from literary sources only. At the *Federmesser* site of Meer II, for instance, the "*pièces retouchées atypiques*" are reported to account for almost a quarter of the entire tool kit[221]. We suppose that this numerical discrepancy when compared with the situation at Rekem (hardly 3% of the tool kit) must primarily be ascribed to the application of different standards of classification by different authors.

5.9 Edge-damaged pieces

Included in this category, are 302 artefacts with (supposedly) non-intentionally modified edge(s). As stated earlier, several pieces that were formerly classified as truncated or randomly retouched tools, finally ended up in this group of artefacts[222]. This occurred after careful and strict evaluation.

Indeed, many other factors apart from purposeful retouch by the prehistoric artisan may have affected the edges of a blank. Certain use-motions were presumably the cause of macroscopic edge-damage, but pieces may also have suffered from accidental factors in the systemic context ('spontaneous retouch' during debitage, rough handling, transport, dropping, trampling, ...), from post-depositional natural mechanisms (subsoil compaction, bioturbation,...), or even from recent damage inflicted during excavation or subsequent handling[223]. Separating pieces affected by these factors from 'intentionally designed' tools has been a concern for generations of prehistorians. While most of these causes cannot

220 Bergman *et al.* 1987.
221 Table 12 in Van Noten 1978.
222 Compare for instance table 1 in De Bie & Caspar 1997 with the present Table 34.
223 Damage from arable activities or other groundwork may be almost certainly excluded at Rekem.

Table 148
Rekem 1984-86. Inventory of the edge-damaged artefacts at the various loci.

Edge damage type	Locus														Total	%
	1	2	4	5	6	7	8	10	11	12	13	14	15	16		
'Use retouch'	2	-	-	5	2	4	2	1	1	1	1	-	-	1	20	7%
Notch(es)	1	1	-	5	3	-	-	2	1	-	-	-	-	-	13	4%
Tiny scars	-	1	-	14	4	-	-	2	1	5	-	-	-	2	29	10%
'Spontaneous retouch'	12	-	-	38	14	3	1	17	8	21	-	-	-	9	123	41%
Recent damage	20	-	-	45	13	5	1	8	7	11	3	-	-	4	117	39%
Total with edge-damage	35	2	0	107	36	12	4	30	18	38	4	0	0	16	302	100%
%	12%	1%	0%	35%	12%	4%	1%	10%	6%	13%	1%	0%	0%	5%	100%	
Total blanks+debris	1514	141	170	2582	1501	572	14	939	561	896	91	326	96	356	9696	
% with edge-damage	2%	1%	0%	4%	2%	2%	29%	3%	3%	4%	4%	0%	0%	4%	3%	

Table 149
Rekem 1984-86. Blank types of edge-damaged artefacts.

Edge damage type	Flake	Laminar flake	Blade Complete	Blade fragment Prox.	Med.	Dist.	Lump	Total	%
'Use retouch'	7	2	7	1	2	1	-	20	7%
Notch(es)	3	-	5	3	-	2	-	13	4%
Tiny scars	2	7	11	6	-	3	-	29	10%
'Spontaneous retouch'	67	24	21	3	2	5	1	123	41%
Recent damage	23	13	47	10	8	15	1	117	39%
Total	102	46	91	23	12	26	2	302	100%
%	34%	15%	30%	8%	4%	9%	1%	100%	

be directly diagnosed, especially not in case of the unpatinated pieces from Rekem, we have nevertheless tried to distinguish five major categories in the large group of 'edge-damaged pieces' (Table 148):

- Blanks with 'spontaneous retouch' (provoked during debitage[224]; N=123).
- Specimens with 'use retouch', *i.e.* scars that were presumably provoked by utilisation (N=20).
- Pieces with one or a few irregularly distributed notches (of unknown origin; N=13).
- Pieces with a short series of tiny edge-scars (of unknown origin; N=29).
- Elements with recently damaged edges (provoked during excavation or later; N=117).

Essentially, all these artefacts should be regarded as non-modified blanks. However, because of the elevated number of '*outils à posteriori*', '*pièces utilisées*', '*Artefakte mit lateralen Aussplitterungen*', etc., frequently encountered in the tables in excavation reports[225], we considered it useful to scrutinise these pieces carefully from a functional perspective. At the same time, they provide a first impression of the use-wear traces that can be found on unmodified blanks at Rekem.

5.9.1 Description

This large group of edge-damaged artefacts contains 152 blades and blade fragments, 102 flakes, 46 laminar flakes and 2 lumps (Table 149). A quarter of these blanks are cortical on more than 1/3 of the dorsal face, and there are 19 trimming pieces (crested blades and tabular flakes; Table 150). Most of the blades have more or less parallel edges and ridges.

All Rekem flint types are involved, except for the fine-grained opaline flint. One piece is too heavily burnt for any recognition of its flint type. More than three quarters of the edge-damaged artefacts are in

224 Cf. Newcomer 1976.
225 *e.g.* Van Noten 1978, Bolus 1992, Fagnart 1996. At Meer II, the excavator recorded even more "*pièces utilisées*" (9% of the industry) than "*pièces retouchées*" (6.5% of the industry; cf. table 12 in Van Noten 1978). We are persuaded that a critical re-evaluation would lead to a severe reduction of this number.

Table 150
Rekem 1984-86. Blank types of edge-damaged artefacts.

Blank type	Flake	Laminar flake	Blade	Lump	Total	%
Cortical piece (> 1/3 of dorsal face)	30	14	33	1	78	26%
Trimming piece	6	3	10	-	19	6%
Blank with ± parallel edges and ridges	5	17	105	-	127	42%
'Irregular' blank	61	12	4	1	78	26%
Total	102	46	152	2	302	100%
%	34%	15%	50%	1%	100%	

Table 151
Rekem 1984-86. Flint types of edge-damaged artefacts at the various loci.

Raw Material	Locus 1	2	5	6	7	8	10	11	12	13	16	Total	%
Undetermined (heavily burnt)	-	-	1	-	-	-	-	-	-	-	-	1	0%
Fine grained grey 'Hesbaye' flint'	4	1	18	11	4	1	7	5	10	-	-	61	20%
Coarse grained grey flint	31	1	85	21	8	3	23	12	27	4	15	230	76%
Mat fine grained grey flint with numerous light dots	-	-	-	1	-	-	-	1	1	-	1	4	1%
Translucent fine grained brown flint	-	-	2	2	-	-	-	-	-	-	-	4	1%
Other type	-	-	1	1	-	-	-	-	-	-	-	2	1%
Total	35	2	107	36	12	4	30	18	38	4	16	302	100%

coarse-grained grey flint (Table 151). A detailed inventory of specific flint types by locus is not (yet) avaliable for this category.

The maximum dimension of the edge-damaged flakes and laminar flakes ranges from 12mm to 146mm with an average of 51 ± 19mm. Detailed measurements for the various edge-damage categories are given in Table 152.

The blades are on average 55 ± 18mm long, 22 ± 6mm wide, and 7 ± 3mm thick. Details of these dimensions can be found in Table 153, and on fig. 78.

5.9.2 The functional significance of edge-damage

Except for 8 small and/or irregular refitted flakes, all of the edge-damaged artefacts have been examined for microwear traces on their edges and ridges. 66 pieces (or 22%; Table 154) showed traces of mechanical (62) or thermal (4) alteration to a greater or lesser extent. However, 7 of these altered pieces still allowed a functional analysis, setting the total number of artefacts that could be diagnosed for microscopic wear to 235 (80%).

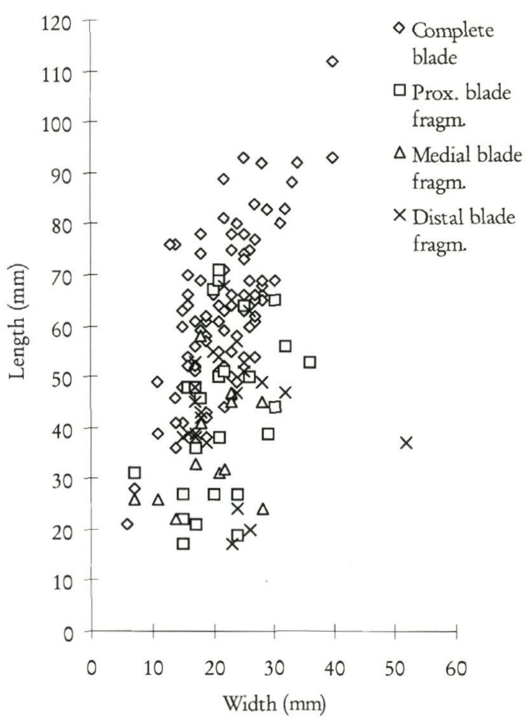
Table 152
Rekem 1984-86. Maximum dimension of edge-damaged flakes and laminar flakes.

	'Use retouch'	Notch(es)	Tiny scars	'Spont. retouch'	Recent damage	Total
Number	9	3	9	91	36	148
Mean of max. length	55	31	47	51	53	51
Standard deviation	27	9	20	20	16	19
Minimum of max. length	30	22	20	12	14	12
Maximum of max. length	117	40	80	146	85	146

Table 153
Rekem 1984-86. Dimensions of edge-damaged blades.

	'Use retouch'	Notch(es)	Tiny scars	'Spont. retouch'	Recent damage	Total
Number	11	10	20	31	80	152
Mean length	59	48	43	61	56	55
Standard deviation of length	20	21	15	17	18	18
Maximum length	80	88	73	112	93	112
Minimum length	20	17	21	22	17	17
Mean width	25	19	18	22	23	22
Standard deviation of width	3	7	5	5	7	6
Minimum width	21	7	6	14	7	6
Maximum width	31	33	27	40	52	52
Mean thickness	8	6	6	8	8	7
Stand. dev. of thickness	2	3	2	3	4	3
Minimum thickness	5	2	2	4	2	2
Maximum thickness	12	13	12	13	24	24

78 *Rekem 1984-86. Length-width measurements of edge-damaged blades.*



Just 12 elements (or 5%; Table 155) carry micro-traces of use, generally presenting one independent use zone (I.U.Z.). One blade with 'spontaneous retouch' presents 2 I.U.Z. representing butchering (Pl. 107: 4).

Except for a blade that probably served as fire-lighter and one artefact used for sawing an undetermined hard material (Pl. 107: 1), all the used elements served in a longitudinal motion on soft or hard animal matter. Traces of butchering (N=5; Pl. 107: 2,4,6,10) and cutting hide (N=4; Pl. 107: 7,11,12) or an unspecified soft animal matter (N=1; Pl. 107: 3; Table 155) were both recognised.

In terms of percentage, most use-wear traces could indeed be found on artefacts that were judged to present macroscopic damage caused by use. However, their limited number, and the fact that the few traces of use were found in all the categories we had previously conceived, warns against a too optimistic belief in a correlation between macroscopic edge damage and effective use-motions. On the other hand, it must be accepted that former microscopic wear has been removed with the chips in cases of heavy use-damage, while in other cases the utilisation may have been insufficient to have left any microscopically observable traces.

Table 154
Rekem 1984-86. Use frequency of edge-damaged pieces.
* use percentage is calculated on the number of pieces suited for microwear analysis (MW) i.e. unaltered elements or pieces with limited alteration that can still be diagnosed.

Edge damage type	Total number	N altered pieces	N suited for MW	N used pieces	% used *
'Use retouch'	20	4	16	3	19%
Notch(es)	13	4	10	1	10%
Tiny scars	29	8	21	1	5%
'Spontaneous retouch'	116	28	93	5	5%
Recent damage	116	22	95	2	2%
Total	294	66	235	12	5%

5.9.3 Refitting

A very large number of the edge-damaged artefacts could be refitted (N=130, or 43%): 120 pieces are involved in sequential refitting (debitage), 20 equally, and 10 exclusively in break conjunctions. Almost half of the refits have been realised at Rekem 5 (Table 156).

This high refitting rate supports the view that most of these elements should be regarded as non-modified blanks (*i.e.* primary debitage waste) left on their place of production. More detailed determination of their origin will therefore be presented in a forthcoming techno-functional study of all debitage waste material. Refitting was most successful in the case of artefacts either with spontaneous retouch or with recent edge-damage (Table 157). In fact, refitting helped in identifying spontaneous retouch, especially in cases of irregularities in the flint. On the other hand, it cannot be denied that the refitting process as such may also have provoked certain types of recent edge damage. If possible, we would suggest that future analyses rigorously record any edge damage on the artefacts before undertaking the refitting procedure.

5.9.4 Discussion

The results for edge-damaged artefacts remain to be compared with a representative sample of 'intact' blanks. It must also be accepted that use in certain instances may have been sufficient to cause macroscopic edge scarring, but not prolonged enough to result in the formation of a use-wear polish. It therefore seems clear that a purely macroscopic evaluation of use (so-called use-retouch) must be approached cautiously.

There are presently very few comparable assemblages. At the *Federmesser* site of Niederbieber, a few

Table 155
Rekem 1984-86. Determination of uses on edge-damaged artefacts.
* calculation of use percentage is based on number suited for microwear analysis (MW).

Edge damage type	Total number	N suited for MW	Type of use: Cutting soft animal matter	Cutting hide	Butchering	Sawing unspec. hard matter	Fire-lighter	Number used	% used*
'Use retouch'	20	16	1	1	1	-	-	3	19%
Notch(es)	13	10	-	-	-	1	-	1	10%
Tiny scars	29	21	-	1	-	-	-	1	5%
'Spontaneous retouch'	116	93	-	1	3	-	1	5	5%
Recent damage	116	95	-	1	1	-	-	2	2%
Total	294	235	1	4	5	1	1	12	5%

Table 156
Rekem habitation zone 1. Edge-damaged artefacts. Refitting results at the various loci.

	Locus											
Refitting type	1	5	6	7	8	10	11	12	13	16	Total	% refitted
Reduction sequence	15	40	4	5	-	7	7	13	2	7	100	33%
Fracture	-	6	-	-	-	4	-	-	-	-	10	3%
Reduction+fracture	2	16	-	-	-	-	1	-	-	1	20	7%
Total refitted pieces	17	62	4	5	0	11	8	13	2	8	130	43%
Not refitted	18	45	32	7	4	19	10	25	2	8	170	57%
Grand Total	35	107	36	12	4	30	18	38	4	16	300	100%
% refitted	49%	58%	11%	42%	0%	37%	44%	34%	50%	50%	43%	

Table 157
Rekem habitation zone 1. Edge-damaged artefacts. Refitting results for the various categories.

Refitting type	'Use retouch'	Notch(es)	Tiny scars	'Spont. retouch'	Recent damage	Total	% refitted
Reduction sequence	4	1	8	45	42	100	33%
Fracture	-	1	1	2	6	10	3%
Reduction+fracture	2	-	-	7	11	20	7%
Total refitted pieces	6	2	9	54	59	130	43%
Not refitted	14	10	19	69	58	170	57%
Grand Total	20	12	28	123	117	300	100%
% refitted	30%	17%	32%	44%	50%	43%	

disparate use-wear traces could be observed[226]. On the other hand, Vaughan[227] noted surprisingly high use-rates and significant differences at the Magdalenian site of Cassegros. Here 43% of the 'scarred flints' were used compared with 17% of the ordinary unretouched pieces. However, it seems that the evidence is too scarce at this moment to permit meaningful conclusions.

5.10 Discussion: tools and 'tradition' in the *Federmessergruppen*

A detailed techno-morphological examination of all tools and their waste products, combined with systematic use-wear analyses and extensive refitting, has allowed us to discuss the use-lives of various types of tool at Rekem in a dynamic approach. Several 'new' aspects of tool manufacture and 'consumption' could be documented, not only with regard to tool categories that generate typical and easily refittable tool waste, such as burins and backed pieces, but also for a seemingly 'ordinary' class of tool like scrapers. These aspects have been discussed at the end of each section.

Shaping mishaps provoked during the production of backed pieces threw additional light on the fabrication process. The making of a backed point seems essentially a continuous process, with a specific 'design' goal. Manufacturing 'accidents' quickly led to discard, without further modification.

A totally different pattern is observed regarding the fabrication and maintenance of burins. Refits show that the burins from Rekem could traverse many different types in the course of (re)tooling. In fact, the Late Palaeolithic burin-maker had three major opportunities to produce and modify a burin (spall removal, truncation (or retouch), and (transverse) breakage). There are only two necessary steps involved in the creation of this type of tool, namely the creation (or selection) of a striking platform, and the removal of at least one spall. The removal of a burin spall is, of course, a *conditio sine qua non* for a burin to exist. It was, however, not necessarily the privileged technique applied in the course of burin transformations. Truncating was at least a coequal potentiality in burin resharpening, and was actually applied at any stage. It did not only serve in the first step of platform preparation but, in the case of the numerous pseudo-Lacan burins, it also acted as the final shaping procedure. The refitting indeed illustrates that the 'finished' form of the burins – in the typological sense – totally depended on the moment of abandonment and was frequently governed by 'exterior' reasons for their discard. The burin types at

226 Bolus 1992.
227 Vaughan 1985, 64.

Rekem do probably not reflect the consciousness of an artisan wishing to establish a preconceived form.

In short, whereas LMP are essentially 'intentionally shaped tools', burins, as well as most other 'domestic tools' (scrapers, becs, composite tools), are primarily end-products of a use-rejuvenation process. They are 'transformation tools' in two ways: they were intensively transformed in the course of their use-lives and they served to transform other materials (hide, bone, stone,...).

Their 'dynamic' character in a technological sense can in fact be regarded as a prolongation of the lithic reduction process that starts with the initial selection of the flint nodule and ends with the abandonment of exhausted, discarded implements. In a broad diachronic perspective, aspects of this entire process are constantly in evolution and therefore are presumably characteristic of specific archaeological traditions. For the 'transformation tools' the following major tendencies can for instance be observed for the Magdalenian and for *Federmesser* groups[228]:

Magdalenian	***Federmesser* groups**
Autonomous and standardised blade production by competent knappers using soft percussion during '*plein débitage*'.	Simplified and versatile laminar and flake debitage by various group members with consistent use of stone hammers.
Specific selection of regular blades by various consumers. Slight preferences ('*archétypes*') for different tool categories (*e.g.* somewhat robust blades for burin manufacture).	Personal consumption of blades, flakes, and waste products by the flint knapper or his immediate neighbours. Inconsequent selection of different blank types for various tool classes (no clear-cut criteria).
Interruption between blank production (the 'collective history') and tool consumption ('individual histories').	No interruptions in *chaine opératoire*; perhaps occasional recycling of 'older' flakes.
Long blades allow for extensive, but generally quite systematic resharpening.	Less elaborate rejuvenation, but flexible combination of various resharpening techniques.
Intensive transport of domestic tools, reflecting a certain conservatism (curation).	Rapid disposal of domestic implements on the spot of use (expedient technology).
Composite tools combining distinct categories (*e.g.* burin/scraper) are not unusual.	Combinations of distinct type of tools (*e.g.* burin/scraper) are rare.

In conclusion, Magdalenian and *Federmesser* artisans in NW Europe adopted a very different strategy (management) while working and consuming lithics. Their technical behaviour can be summarised, respectively, as governed by strict ruling (Magdalenian) *versus* extremely versatile (*Federmesser* groups). Although we can begin to perceive 'transitional' stages in between (*e.g.* "*Federmesser Ancien*" in Northern France), these 'fundamental attitudes' essentially apply to all groups belonging to either one of these traditions. The "strong tradition" in case of the Magdalenian debitage is mirrored in the coherence of tool manufacture processes (more rigid selection of blades, more 'systematic' resharpening procedures,...), which ultimately may have led to explicit and recurrent regional (or chronological) features in the material culture (*e.g.* a preference for burins on truncation in certain facies versus dihedral burins in others; signs of lateralisation in case of truncation burins; regional Magdalenian facies like the Creswellian; etc.). Whether or not this 'structured' behaviour was imposed by a 'structured' environment (established migration routes of herd animals leading to patterned behaviour) is not an issue here. However, despite earlier claims, *Federmesser* industries, presumably operating in a different natural environment, do not seem to display such regional facies ('territories'). If major differences in the lithic assemblages could be noted (for instance the assemblages of the Neuwied basin in Germany versus those of Northern France) these could mostly be linked to raw material constraints and therefore could be interpreted as representing adaptation to a different environment (cf. transport over long distances with connections to the Meuse Region). It is not inconceivable that the versatile and 'adaptive' character of *Federmesser* people prevented the emergence of rigid traditions in the lithic industry. Delimiting *Federmesser* 'territories' based on the (lithic) material culture, therefore, remains an intricate endeavour.

228 Note that these are very general characterisations. Beside these major tendencies, considerable variation can be observed. Inside a Magdalenian settlement, individuals with only basic knapping skills, could also make non-standardised blanks and tools to satisfy individual needs (Bodu 1996).